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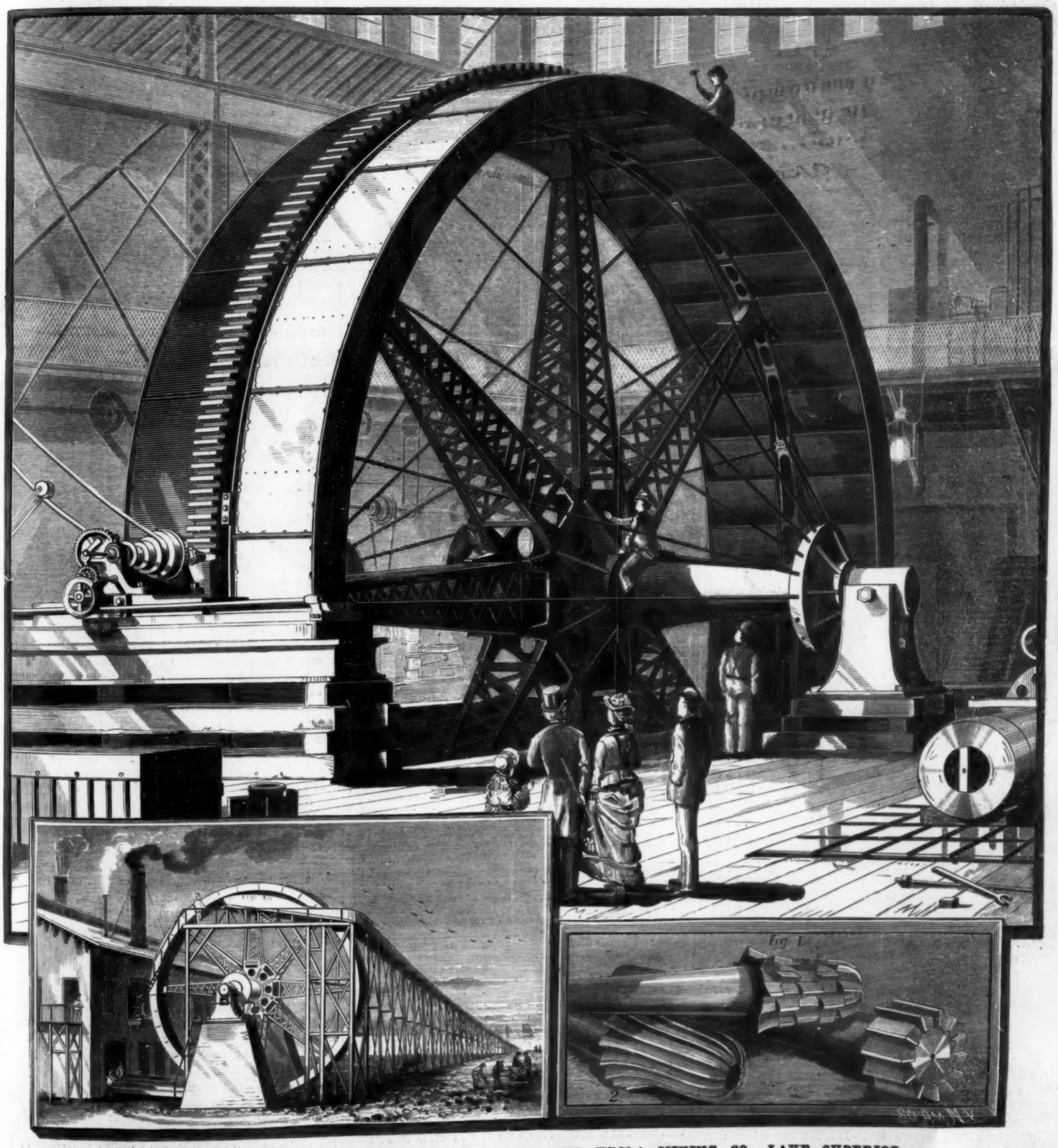
GIGANTIC LIFTING WHEELS FOR THE COPPER MINES.

At the copper mines of the Calumet and Hecla Mining Company, on the borders of Lake Superior, the amount of refuse resulting from the process of mining is sufficient to cover an acre of ground one foot deep every forty-eight hours. The disposal of this enormous mass is only accomplished by great labor and at heavy cost. It cannot be drained to a locality where it would be out of the way, as the elevation of the mines is not sufficient. The inconvenience, trouble, and expense consequent upon the present method of handling the waste products have been done away with, and the question solved by the use of wheels of mammoth proportions, which raise the debris to such a height that it will flow off into the lake. Two of these wheels have been ordered: one was completed some time since and sent to the mines; the other is nearly finished, as shown in our engraving, which represents it standing in the shops of the Dickson Manufacturing Company, at Scranton, Pa., where both wheels were built.

The shaft of the wheel is made of gun iron, and is 30 inches in diameter. It rests on ponderous pillow blocks having universal bearings. From the octagonal hub radiate wrought iron arms, which are pyramidal in form, and are built up of four corner pieces converging toward the periphery of the wheel, and united together by lattice work. The ends of the arms, known as the bucket segments, are of cast iron, and to them are bolted the spur segments and buckets. All the parts are held together by turned bolts that were driven in reamed holes.

The spur gear on the periphery is made up of sixteen pieces, is 43 feet in diameter at the pitch line, 4⅝ inch pitch, 12 inch face; all the teeth, 352 in number, have been cut epicycloid, and are mathematically correct. There are twenty-five double elevating buckets or inverted pockets on each side of the spur gear, making 100 buckets in all, which are stationary on the inside of the periphery of the wheel, and are capable of scooping up at a single revolution nearly 2,000 gallons.

The most important feature of the wheel is the manner in



THE GREAT LIFTING WHEELS OF THE CALUMET AND HECLA MINING CO., LAKE SUPERIOR.

which the spur was constructed. The teeth were laid out by hand, a prick-punch mark locating each tooth. The teeth were cut by an ingenious device suggested by such a great task and specially planned for this work. The work was done by two cutters located one on each side of the wheel at diametrically opposite points. One of these cutters is shown in the engraving. The rest holding the tool traveled on a bed placed just outside the periphery and in a line at right angles to the plane of the wheel. Figs. 1, 2, and 3 represent the cutting tools used; Fig. 1 was used as a stock cutter, the peculiar shape and arrangement of its cutting edges enabling it to rapidly and easily clear itself; Fig. 2 was used as a finishing cutter; and Fig. 3 was used to cut the face of the teeth. So successfully did the tool shown in Fig. 1 work, its clearing powers permitting deep cuts without the danger of heating, that it is probable that it would be used alone—to the exclusion of the finishing cutter—in another job of this kind. By working upon both sides of the wheel at once the time occupied in milling and cutting the teeth was 215 hours, and the probability is that with the old plan of milling it would have taken four times as long.

The same process was used in the construction of the machinery for driving the Brooklyn Bridge cable, the company having received both orders at the same time.

This wonderful wheel is to be used to remove the refuse from the copper mines. It will be set in solid masonry, with arches through which the launders used for washing the ore will pour their contents, to be taken up to the buckets already described and deposited in outlet launders placed at an elevation of 40 feet, which will afford sufficient impetus to carry the waste into Lake Superior.

The whole will be driven by a steel spur pinion, the shaft of which will be actuated by an engine of 175 horse power. It will make about four revolutions per minute, lifting 8,000 gallons in that time, or 480,000 gallons each hour.

The combined weight of both wheels is 124 tons, and their cost in place will not be less than $50,000.

The Dickson Company is also building two of the largest locomotive fire box boilers ever made, being 1,000 horse power each. They are made of steel plate nine-sixteenths of an inch thick. Each boiler will contain 199 three inch lap-welded tubes 16 feet long. These boilers will weigh 61 tons each, and will be used to work the immense machinery of the Calumet and Hecla Mining Company.

The Correspondence University.

This is the title of an association of experienced instructors judiciously selected for their knowledge of the subjects assigned them and their ability as teachers. That sectarianism did not govern their selection is clearly shown by the fact that eight graduated at Cornell, six at Harvard, three at Yale, two at Amherst, and one each at University of Michigan, Michigan Agricultural College, Worcester Free Institute, Massachusetts Institute of Technology, Johns Hopkins, Vassar, Marietta, Brown, Columbia, and University of Lewisburg, besides several from abroad. Many, also, had taken post-graduate courses at Johns Hopkins.

Students from whom the necessity of close mental application has been removed quickly lose the power of concentrating the faculties for any length of time. Those who have been away from school or college for some time, and have stopped study, know how difficult a task it is to learn; they also know what a hard, tedious, and discouraging undertaking it is to regain this power. That it should ever have been lost is to be regretted, and a system which will insure its reinstatement, and be incentive to those now possessing it never to lose it, is most certainly needed, and will be most heartily appreciated.

The objects which the Correspondence University aims to accomplish are most meritorious. Primarily, it hopes to stimulate to methodical study those who might otherwise find no opportunity for intellectual work, and to imbue them with the pleasure and profit arising from such application.

It is intended to directly benefit those engaged in professional studies which can be taught by correspondence; graduates doing advanced work; under-teachers in schools and colleges; those preparing for college; members of cultivated families who are obliged to live in remote localities; officers and men in the army or navy; persons intending to try any of the civil service examinations; young men and women engaged in occupations which prevent their attending school and yet who desire to learn.

The fee for four weeks' tuition in any study of the grade required for admission to a college and in some collegiate studies is $6.35; in studies of an advanced grade the fee is $8.25. The list of studies now includes, agriculture, astronomy, botany, drawing, engineering, engraving, military science, music, physiology, zoology, mathematics, Greek, Latin, English, German, Hebrew, philosophy, history, political science, and law. Mr. Lucien A. Wait, the Secretary, of Ithaca, N. Y., is the proper person to address for full particulars.

THE French inventor who some time ago patented a machine for the use of concentrated solar rays as a general motive power, has set up three of his machines in Algeria for the French Government. He is now carrying on his experiments at the Island of Porquerolles, near Hyeres, in France, where he is thrashing Indian corn and raising water by the action of the sun's rays. It is not stated how much work he is able to accomplish, though.

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PRESENT STEAM ENGINE PRACTICE.

There has been much comment by correspondents in the various engineering journals during the past year, in regard to the present status of steam engine practice; much of it apparently by parties more or less interested in the manufacture or success of some of the special types in progressive engine building.

The special pleading of interested parties is doubtless legitimate in a business point of view, as may be also that of the advocacy of professional engineers who betake themselves to mathematical theories that begin and end in nothing more tangible than algebraic formulas and arithmetical deductions.

What is most wanted among steam users *is*, not what has been made some special test for gaining a small percentage in coal or power for a short and especially arranged trial, but, rather, what engine wears the longest, is liable to the least breakages, gives the least trouble, and runs steadily with a reasonable economy in both coal and oil?

These are pertinent questions, in which steam users themselves are interested and ought to have something to say from their own experience and time trials with these highly recommended types. They should know, not only how much coal is used for a given amount of power for a given length of time, but they should also know where it goes. How much of its value goes up the chimney; how much suffers a useless waste by radiation and leakage; and how much of the heat of the valuable exhaust is lost, or saved and returned to the boiler, or utilized for other purposes; that the engine may not be laid at fault, at the feet of a wasteful generator or more wasteful practice in the lack of heat saving adjuncts. For herein lies very much of the trouble with the coal pile.

There are, no doubt, special considerations requiring high speed engines running with high pressures, necessitating a more costly construction in material and workmanship, such as for locomotives, propellers, and their like, in which compactness and power must be had with the least material in both engine and boiler.

In such engines well considered devices, together with the use of steel and the best anti-friction alloys, for the purpose of strength and wear, have largely contributed to their present perfection.

But for the purposes of continued and steady power, the plea for high speed engines, because of less first cost and small space, cannot avail; for the difference in cost can scarcely compensate for the trouble of maintaining the adjustments due to high speed wear. Again, the difference in cost is not equal to the difference in size, from the necessity of making the wearing parts of hardened steel and the best anti-friction metals, while the strength maintaining parts should be also of steel, that such an engine may have a life in common with its less pretentious and longer tried rivals.

The absolute requirement of oil for legitimate use becomes a matter of serious concern when it is diverted to the cooling of hot bearings and other wearing surfaces, bespattering both engine and floor with valuable oil and still more valuable abraded metal.

It is improbable that any one type of engine can take the lead for all purposes and requirements of power, as the cost and conditions of use naturally lead to the choice of any one of the many styles.

In the class of engines with revolving valves, with their small percentage of clearance, partially compensated for by cushioning, will no doubt be found the engine of the future for steady, enduring, and economical work, as the power for our factories and workshops; for they certainly contain in the latest methods of construction the elements of economy, durability, and perfect control.

There seems to be a disposition to overreach the limit of economic expansion from an apparently popular idea, "that the greater the expansion, the greater is the economy in fuel;" but by pushing expansion too far there is less pressure upon the piston in the latter part of its stroke than is required to move the engine and overcome its friction, thereby finishing the stroke of the piston by momentum; thus involving a negative value to a part of the stroke. This is very doubtful economy.

Probably the most economical of all the engines now in use for developed horse power per pound of coal is found in the compound type, wherever the element of condensation is economically available.

The boiler pressure has no doubt a very large influence in the economical rating of all engines, and which is often left out in the comparative statements of parties setting forth the merits of their specialties; nor does high pressure or medium pressure cover the true relations between the boiler and the engine.

The economy of the boiler should have an equal consideration with that of the engine, and should be ample in all its capacities, so as to enable it to absorb so much of the heat generated in the furnace, that the excess passing up the chimney shall be the least possible with the necessities of draught; for unless all possible channels of waste are cared for or closed, we may go on and save at the spigot of fine spun expansion curves and waste the savings many times at the bunghole of the chimney.

There are other economies obscurely practiced that should become available to every well regulated steam plant, such as drawing the air for the furnaces from the ceiling of boiler and engine rooms, instead of wasting their heat by ventilating to the open air. Further, to utilize the waste of the heat of the chimney in heating the air fed to the furnace,

thus adding from 200° to 300° of heat to the furnace products of combustion.

Last, and possibly least, the injection of a small portion of the exhaust under the furnace as an auxiliary to combustion. These comprise a few of the neglected elements of modern steam practice.

FORMING SPIRAL SPRINGS.

Ordinary spiral springs, unless of unusual size and heavy tension, are commonly wound from wire; but some are wound from square steel, as those for railroad cars. For these latter, and indeed for any larger than No. 3 wire, Brown and Sharpe gauge, spiral machinery must be used. There are machines built for winding spiral springs which work wire from that gauge to smaller sizes, but wire from No. 6 down may be wound into springs on the lathe. This process is a simple one if certain preliminaries are observed. If the finished spring is to be of a certain external diameter to fit some cylindrical cavity, it should be wound on a core suitable for the purpose, and the diameter of this core may differ with the difference of the material of which the wire is made. Hard drawn iron and hard drawn brass make springs that require no tempering, but the spring of brass wire of the same gauge as that of iron wire will expand much more when released than the iron spring. The only method of determining the finish extreme diameter of a wound spiral spring is to make two or three turns on a core or arbor, and measure until the proper diameter is attained. So much is this exact diameter a matter of trial that the manufacturers of tools for these purposes advertise in their catalogues that the first former of any pitch is apt to be expensive, as trials are necessary to attain the desired result. But it is not well to crowd the diameter of the spring; a good rule is to give a minimum diameter of eight times the diameter of the wire used in forming the spring. As instances, No. 3 wire, which is nearly one-quarter of an inch diameter, should make a spring of two inches, and No. 11 wire, 0·12 or one-eighth of an inch, should make a spring of 0·96 of an inch, or one inch minimum diameter.

Consideration should be taken of the fact that a close or expanding spring diminishes its diameter under tension, while an open or contracting spring expands in diameter under tension. The amount of this diametrical expansion or contraction is not a constant with wire of the same gauge or diameter if of differing material, and it can be ascertained only by trials, as before suggested. In short, the formation of spiral springs of wire is empirical so far as tensional power is concerned as compared with diameter of wire. This statement receives illustration in the fact that the manufacturers of spring balances, so generally used for weighing moderate weights, test every spring, and do not depend on diameter of wire or of spring, or on the supposed uniformity of material. So the mainsprings of fire arms, which are modifications of the spiral spring, are severally tested, although made of steel of the same quality and to a uniform gauge, and are tempered as much alike as is possible.

To wind a close spring in a lathe is simply to fasten one end of the wire in the dog that carries the core, or arbor, and lead the wire against the previous round as it is formed. This may be done by hand, but if the lathe has a screw or other variable feed, that may be used for guiding the wire; thus, a feed of eight to the inch will make a close spring of No. 11 wire. If an open spring is desired, two may be wound at the same time. The best open or compressible spring is one the interstices between the coils of which are the same as the diameter of the wire. So, if two wires are led at one time, a double spring will be formed which may be separated into two springs by uncoiling or unscrewing them when formed. If a more open spring should be required, it may be wound by means of a simple guide, a piece of iron of the thickness required to form the spaces between the successive coils. This should have a hole through it to receive the core, or arbor, and a small leading hole for the passage of the wire. Once started, the guide is held by the operator pulling toward him (the lathe running reversed), and the wire follows and is laid in coils or rounds just as far apart as the thickness of the guide.

HOSTILE PATENT BILLS NOW BEFORE CONGRESS.

House bill 3,925, introduced by Hon. Mr. Calkins, of Indiana, provides substantially that if the inventor or owner of a patent shall dare to attempt to sustain his rights by bringing a suit against infringers, he shall recover no costs, and shall pay to the infringer's lawyer a counsel fee of $50. This bill was passed in the House of Representatives by an enormous majority, on January 21, and is now before the Senate for concurrence. The members who voted for it apparently regard it as a very upright proceeding to encourage the inventor to reveal his invention by passing laws to give him a patent, and then passing other laws to deprive him of the benefit of said patent. This is the way Congress exemplifies integrity and fair dealing before the people.

House bill 3 934, introduced by Mr. Vance of N. C., provides substantially that any person may use any patented article he pleases without liability, but shall become liable after receiving notice that a patent exists; and may then require the patentee to give him the use of the patent for a royalty to be named by the courts, thus robbing the patentee in the first instance and then depriving him of the control of his patent. This bill was passed by the House, January 22, 1884, by a vote of 114 ayes to 6 noes.

The texts of the foregoing bills will be found on page 73 of the SCIENTIFIC AMERICAN for Feb. 2.

House bill 3,617, introduced by Mr. Anderson, of Kansas, reduces the lifetime of a patent from 17 years to 5 years. Not yet passed, but perhaps soon will be by a great majority, as there is no member in the House who has so far ventured to say a word in protest or speak in favor of inventors or the present patent system.

In the Senate the bill introduced by Mr. Voorhees, of Indiana (S. 1,558), provides in effect that all patents shall be free to the public. We gave the text last week. This bill caps the climax; it has not yet passed; but soon will be if the members of the Senate share in the views of the House majority.

Once more we entreat all friends of the patent laws and of home industries to exert themselves in every possible way to enlighten and influence their senators and representatives against the consummation of these ill-considered and dishonorable enactments. Letters of remonstrance, protests, petitions, should be forwarded to Washington without delay.

THE NILE AND THE SOUDAN.

To fully understand the situation in Egypt, one has to look beyond the map of Egypt proper. The government of the late Khedive placed the territory of Egypt and its dependent provinces at 1,406,000 square miles (hardly one-half of which is shown in the accompanying map), with a population of 17,000,000. The area of Egypt proper, however, could hardly be considered to extend above the second cataract of the Nile, embracing 175,000 square miles, with a population of 5,500,000. This limit would be some 500 miles below Khartoum, at the junction of the White and the Blue Nile, which the late government made the head-

quarters of its operations in the Soudan. So far as this, and even to El Obeid, 200 miles to the southwest, the authority of the Khedive was generally respected, and was at least of much more potency than that of the native chiefs.

But the whole territory of the Soudan extends from Abyssinia on the east to Senegambia on the west, or pretty nearly from the Gulf of Aden on the Indian Ocean to the Atlantic. The territory thus designated, reaching from about the tenth to the eighteenth degree north latitude, and covering some 2,000 miles from east to west, has a population, according to Behm and Wagner, the German geographers, exceeding 78,000,000. For about one half the population of this belt of fertile country across the African continent, just south of the Sahara desert, the Niger and its branches afford means of communication, and the Atlantic coast trading posts in Senegambia and Guinea the natural channel for trade with the rest of the world. For the other portion, or for a population estimated at 35,000,000, independent of that of Egypt proper, the only trading heretofore done with the world has been through the Nile Valley or the Red Sea ports. Work is hardly necessary to live in this region, very little animal food being used, and a few farinaceous articles being raised almost without attention. They export ostrich feathers, elephants' tusks, senna, gum arabic, and a few spices, with the proceeds of which they purchase coffee, tobacco, cotton cloth, firearms, and knick-knacks.

The trade, and in fact the government, of such portion of the Soudan as Egypt ever claimed has been done principally through the sheiks and the petty chiefs they controlled, but the main item of profit in the business, for the government and the sheiks alike, was in the marketing of slaves from this Soudan region.

When the English and French assumed the joint control, and cut off or largely reduced the profits from this business, they started the general feeling of discontent of which Arabi and El Mahdi were only the exponents. El Mahdi (or El Muhdi, as he should be called, to give him his 1,000 year old authority as the deliverer of the Mussulman world) represents the tribal interests of this Soudan population in two strong points—first, as the opponent of interference with a trade in which their leaders have found almost all their profit; and, second, as himself the representative of the promised Mohammedan supremacy and triumph in the world. It is perhaps, now, the indefinable and incalculable force their peculiar fanaticism may assume which presents the only uncertain quantities that have to be dealt with. The country is one of the most fertile in the world, and almost as thickly populated as any portion of India, but the natives are effeminate and ignorant to the last degree; they are, however, substantially governed by Arab chiefs, who keep up constant intercourse with the Mohammedans of Turkey, Arabia, and India, and are making strenuous exertions to enlist them all in a crusade for "the Faithful."

The map herewith given shows the scene of the late operations around the Red Sea port of Suakim, and will give an idea of the relative situations and distances of the principal points thus far mentioned in connection with the campaign of the False Prophet.

DECISIONS RELATING TO PATENTS.

U. S. CIRCUIT COURT.—SOUTHERN DISTRICT OF NEW YORK.
UNITED STATES *vs.* GUNNING *et al.*

Wallace, J.:

There is no distinction between letters patent for an invention and for land as regards the rights and remedies for vacating them when obtained by fraud. The right is the same as that which a State has to annul the charter of a corporation created by its legislature if obtained by fraud.

The appropriate remedy in behalf of the United States when a patent for an invention has been obtained by fraud is by a bill in equity.

U. S. CIRCUIT COURT.—NORTHERN DISTRICT OF NEW YORK.
ROBERTS *vs.* WALLEY.

Coxe, J.:

In a suit for the infringement of a patent, where the validity of the patent and the infringement are denied, the complainant cannot, as part of his preliminary proof, compel the defendant to disclose the names of his confidential customers to whom he has furnished articles alleged to be covered by the patent, but he may be required to give the name of one person to whom he has furnished such articles.

The examiner has no power to rule on the admissibility of evidence, and defendant, when a witness before him, has a right, upon a question not free from doubt, to take the opinion of the court; and when he refuses to answer under advice of counsel and apparently in good faith, he should not be punished for contempt of court, even though he acted mistakenly.

UNIFORMITY OF SHOP HEAT.

Measurements of the metals in working are reduced to such exactness that very slight changes of external conditions affect their integrity. When a company that produces exact standards of measurement claims an accuracy of one five-hundred thousandth of an inch in linear measurement, and advertises to produce it, and another producer of tools of exactness insists on fitting work to one fifty-thousandth of an inch, it may be considered that extraneous influences not formerly noticed may be sufficient to seriously affect these measurements. One of these influences is that of shop temperature. Exact measurements must be taken under certain temperamental conditions; when these conditions vary within limited periods, or while the job to which they pertain is in progress, there will be a difference that in some cases would be sufficient to impair the accuracy of the work. In one instance noted, a planer stood by the wall of the shop, the head-upright close to a window. When the planer stopped on a winter night there was on its platen a lathe bed nearly finished, the Vs lacked only the finishing chip. The tool carriage on the cross saddle had been left on the inner or shop side. In the morning, after a blustering, cold, windy night, the operator thought to test the theory of cold contraction, and he set the square-nose finishing tool to touch the top of the V on the shop side and ran it across to the wall side. The cutter scored across the cold side of the planer, plowing a gouge of at least one thirty-second of an inch deep in the opposite V, a distance from the other V of but little over two feet.

Technical Schools in Saxony.

The amount of attention given to purely technical education in Saxony is shown by the fact that there are now in that kingdom the following schools: A technical high school in Dresden, a technical state institute at Chemnitz, and art schools in Dresden and Leipzig, also four builders' schools, two for the manufacture of toys, six for shipbuilders, three for basket weavers, and fourteen for lace making.

Besides these there are the following trade schools supported by different trades, foundations, endowments, and districts: Two for decorative painting, one for watchmakers, one for sheet metal workers, three for musical instrument makers, one for druggists (not pharmacy), twenty-seven for weaving, one for machine embroidery, two for tailors, one for barbers and hairdressers, three for hand spinning, six for straw weaving, three for wood carving, four for steam boiler heating, six for female handiwork. There are, moreover, seventeen technical advanced schools, two for gardeners, eight agricultural, and twenty-six commercial schools.—*Deut. Industrie Zeitung, No.* 3.

Tornadoes.

In commenting on the terrible tornadoes which have lately raged in the South, the New York *Herald* says that the tornado which is reported to have demolished a thousand residences in the northwestern part of Georgia was a typical storm of its class, evidently due to an unusual northward movement of the Gulf air, laden with tropical vapor. Such violent gyratory storms, consequent upon excessive condensation of vapor, can only take place in the presence of the humid equatorial current. But as the latter is now struggling to spread itself over the Gulf States, and will gain fresh force with every day's advance of the sun toward the northern tropic, tornadoes will increase in frequency till July. Out of nearly six hundred tornadoes examined by Mr. J. P. Finley, of the Signal Service, the relative frequency of their occurrence by months was twenty-one in February, thirty-seven in March, ninety-seven in April, after which the numbers slowly increase to one hundred and twelve in June.

The peculiar shape of the barometric depression which gave rise to Tuesday's tornadoes should be noted by meteorologists, as it suggests the conditions under which these storms originate in greatest intensity and may be more surely foretold. On Tuesday morning, February 19, the depression had taken a distinct trough shape, reaching from Lake Superior to Arkansas. In connection with just such a depression ("much elongated in form" and extending from Louisiana to Kentucky) occurred the fearful tornadoes which ravaged Alabama and Georgia on March 20, 1875. The northeasterly extension of a low pressure area crossing the country, by facilitating the rush of warm, vapor laden atmosphere from the Gulf and allowing its elevated strata to acquire great velocity, seems to favor the genesis of the most destructive tornadoes. That this explanation is correct is confirmed by the fact that the storm-bearing Gulf current on Tuesday reached the latitude of Petersburg, Va., where at midnight "a tremendous thunder storm burst over the city, followed by an immense rainfall and a heavy gale of wind."

IMPROVED STEAM COOKER.

The accompanying engraving represents an invention recently patented by Mr. Hudson Maxim, of Pittsfield, Mass. Fig. 2 is a sectional elevation. The cylindrical vessel, A, closed at the bottom and open at the top, is held in the upper part of a conical vessel, B, the upper edge of which is securely fastened, steam tight, to the outer surface of the vessel, A, at about one-third of its height. A tube, C, extends from the bottom of the vessel, B, to the upper edge of the vessel, A, and at its upper end has a screw neck on which a cap, D, fits. The tube is provided with a cock, E, below the bottom of the vessel, A. A pipe, F, much smaller than the tube, C, extends from the top of the tube through the bottom of the vessel, B, and is then carried forward and back across the bottom of the vessel, and is then turned into a spiral between the bottom and layer of pipe already formed, and is finally carried through the bottom of the vessel, B, to the bottom of the upper vessel, where it terminates at G, the end of the pipe being flared and provided with an upwardly opening check valve, H.

The cover, I, which fits over the vessel, A, is of such height that it extends down to the top of the under vessel. It is provided with an annular groove, J, containing a packing strip which rests against the upper edge of the vessel, A, when the cover is on. The top of the cover has a weight, K, to prevent the steam pressure from raising it. The upper end of the pipe, F, is bent downward, so that water poured

MAXIM'S IMPROVED STEAM COOKER.

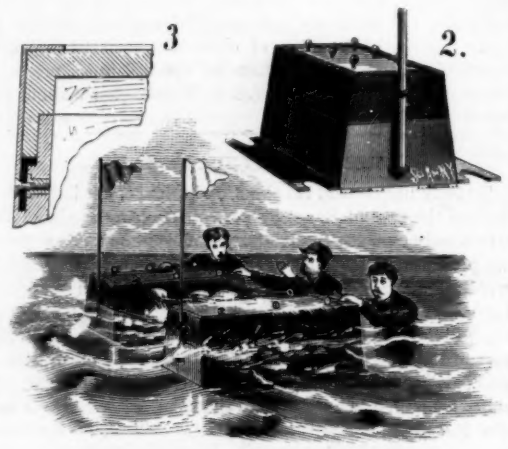
through the tube to fill the lower vessel will not pass into the pipe.

After the vessel, B, has been filled with water the cooker is placed on the fire, when the water is converted into steam, which rises in the tube, C, passes through the pipe, F (in which it is superheated), and enters the vessel, A, when it cooks the articles placed therein. The steam then escapes at the top of the vessel, A, and passes down between the sides and cover, heating the sides. The valve, H, prevents solids or fluids contained in the vessel from entering the pipe.

The food in the chamber, being subjected to steam superheated to a high temperature, is cooked rapidly, and without the loss of any of the soluble salts.

TRUNK LIFE PRESERVER.

The trunk shown in the accompanying engraving can be used as a float to save lives at sea. It is made of very light wood or cork, and is furnished with a covering that makes it absolutely waterproof. The trunk is composed of top and bottom sections (shown in the perspective view Fig. 2, and in Fig 3, which is a section through the side showing the joint), provided with lap joints, between which rubber packing rings are placed. The sides of the trunk have an upward inclination from the bottom, thus giving it a broad base, which enables it to ride better and safer on the water. A wing made of cork, or other buoyant material, is pivoted to the bottom along each longitudinal edge. These wings can be folded under the bottom when



ESCHENHORN'S IMPROVED TRUNK.

the trunk is not in actual service as a life saving device. On top are rows of eyes for fastening a rope to which a life preserver can be attached, or two or more trunks can be united by means of the ropes to form a raft, as indicated in the lower illustration. The wings materially increase the buoyancy and stability of the trunk. The interior is divided into compartments in the usual manner.

Further information concerning this invention can be obtained by addressing Mr. E. Gustav Eschenhorn, 17 New Kölln a. W., Berlin, Prussia.

Heating Gases.

Dr. H. Bunte delivered a lecture before a German gas and water association, from which the *Chemiker Zeitung* makes the following abstract:

The speaker divided the gases used for heating into five classes, namely: 1. Illuminating gas. 2. Generator gas. 3. Water gas. 4. Mixed gas (Schweelgas). 5. Generator water gas. These gases are made as follows: Illuminating (or coal) gas is made by distilling bituminous coal in red hot retorts; generator gas, by burning coke in air so as to produce only carbonic oxide; water gas, by decomposing steam with red hot (anthracite) coal; schweelgas is a mixture of illuminating gas and generator gas, and is obtained by feeding the generator with coal instead of coke; generator water gas is produced when a coke generator is fed with air and steam together.

The composition and heating power of each are given in round numbers in the following table:

	Carbonic oxide.	Hydrogen.	Hydrocarbons.	Carbonic acid and nitrogen.	Heating effect.
1. Coal gas	9	47	39	5	5511
2. Generator gas	34·3	....	....	65·7	1048
3. Water gas	50	50	....	....	2813
4. Schweelgas	20	6	2	72	1045
5. Generator water gas	38	12	...	50	1470

Of these five kinds, those with small heating power require very large pipes; the Beckton and London Company have two 4 foot mains. Generator gas as well as schweelgas possesses another disadvantage for household use, that they are difficult to ignite. Aside from their cost, water gas and illuminating gas are to be considered as the only general sources of heat supplied from some central plant. From economical considerations it has been proposed to separate the first portion of the coal gas, which is rich in hydrocarbons, from the second and less luminous portion, and to send them through separate pipes to be used, the former for illumination, the second for heating only. But aside from the cost of material for making coal gas, there is the further expense of two sets of pipes, which is a very large one.

The lecturer thought that the American method of making water gas and carbureting it with naphtha solved the problem for both lighting and heating. Or, the carbureting may be omitted and the pure water gas employed for illumination in the so-called incandescent lamp.

In a discussion that followed this lecture H. Von Quaglio stated that the cost of naphtha in Germany being much greater than in America was a serious obstacle to the use of carbureted water gas there, but that he had great expectations from the incandescent lamps. Lewis', Popp's, and Clamond's lamps have a disadvantage in that they require the use of compressed air, but Clamond has invented a new form of lamp in which a tissue of magnesia fibers is heated to a glow without compressed air. This new lamp gives a very agreeable light of 27 to 30 candles with a consumption of 120 liters (4¼ cubic feet) per hour.

There is a water gas generator in Schultz & Knaudt's factory in Essen, which works very satisfactorily.

They All Knew How.

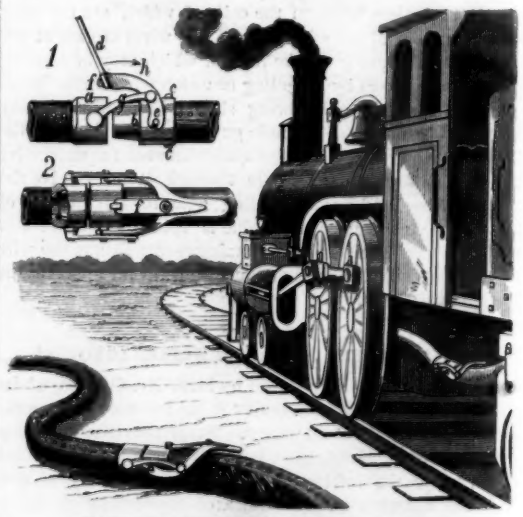
A writer in the Portland (Me.) *Press* says that he took a spider from his web, put him on a chip, and set him afloat on the quiet waters of the pond. "He walked all about the sides of the bark, surveying the situation very carefully, and when the fact that he was really afloat and about a yard from shore seemed to be fully comprehended, he prospected for the nearest point of land. This point fairly settled upon, he immediately began to cast a web for it. He threw it as far as possible in the air and with the wind. It soon reached the shore and made fast to the spires of grass. Then he turned himself about and in true sailor fashion began to haul in hand over hand on his cable. Carefully he drew upon it until his bark began to move toward the shore. As it moved the faster, the faster he drew upon it, to keep his hawser taut, and from touching the water. Very soon he reached the shore, and quickly leaping to terra firma, he sped his way homeward. Thinking, then, that he might be a special expert, and an exception in that line of boatmanship to the rest of his companions, I tried several of them, and they all came to shore in a like manner."

Bird Migration.

The American Ornithologists' Union asks the assistance of field collectors, sportsmen, and all observers of nature in North America, in their investigations on the subject of the migration of birds in the United States and British North America. They not only want time arrivals, but all data showing the causes influencing migration from season to season, such as the weather, opening of leaves and plants, abundance of insects, etc., affecting the robin, mocking bird, bluebird, catbird, barn swallow, bobolink, kingfisher, whippoorwill (when first heard), nighthawk (when first seen), and, in fact, all the migrating birds. Thirteen districts have been established, covering the whole country, to whom residents are asked to send their reports, and a plan of the work laid out may be obtained of C. Hart Merriam, chairman of the Committee on Migration, Locust Grove, Lewis County, N. Y.

IMPROVED HOSE COUPLING.

The engravings represent a hose coupling, recently patented by Mr. Samuel Hamer, of Salt Lake City, Utah, which can be locked so that it cannot be uncoupled accidentally. Fig. 1 is a side elevation, showing the hose sections uncoupled. Fig. 2 is a plan view, showing the two sections coupled. On the end of one hose is a tubular socket, *a*, which receives the tapering neck, *b*, on the end of the other hose. At the bottom of the socket, *a*, is a groove that holds a packing ring, against which the outer end of the neck, *b*, is held. This construction is shown in the part broken away in Fig. 2. A fork, *h*, terminating in a handle, has the ends of its prongs recessed in order that they may rest on two pins, *e*, projecting from diametrically opposite points of the neck. Near the ends of the fork are pivoted two links, *g*, the opposite ends of which are pivoted to the



HAMER'S IMPROVED HOSE COUPLING

outside of the socket, *a*. The fork can be entirely detached from the neck, *b*. A spring lever, *f*, is pivoted on the cross piece of the fork at the base of the handle, and is furnished with an end notch. The neck, *b*, is provided with studs, *e*, which are to be passed into the notch in the spring lever. When the two sections are coupled, the spring lever is swung so as to be parallel with the handle, *d*—during the operation of bringing the ends together it having been at right angles to the handle—so that one of the studs, *e*, can pass into the notch in the lever, which is thereby locked in place, and which, in turn, locks the fork in place, and prevents accidental uncoupling. It will readily be seen that the device is easily and quickly operated, and the hose sections firmly united.

Fence Cutting in Texas.

"Fence cutting," said a native who knows Texas like a book, "is the protest of a very peculiar people against evils quite as remarkable and nearly as outrageous as the present trouble growing out of them. Scattered among the public and private lands in the grazing country are school lands that could be made to produce a revenue that would do away with the school tax. In the same country are little farms worked by settlers, and little nests which used to be the headquarters of those liberty-loving Texans who pastured their cattle on the open country, and never dreamed that it did not belong to them and to all mankind in common. In this country there are few roads. You might confine yourselves to patches as big as half New Jersey, and say there are no roads at all. Water holes and water courses, regarded as God's endowment to the cattle raisers, seam the prairie. Imagine great corporations, whose stock is owned in Paris, London, New York, and Chicago, suddenly buying up vast tracts and fencing in whole counties, even two whole counties together. Imagine their vast herds let loose to pasture on the public lands (used, though with no better right, by the nesters), and only taken into the fenced lands in the winter.

"Imagine," he continued, "these fences inclosing squares of school land that never have been leased, boxing in water holes and streams that the nesters and cattle depended upon for life, inclosing the little farms and nesters' tracts, and pasture lands of small beginners; shutting in the roads and trails, and everything for miles upon miles of territory in their tremendous grasp. Imagine, also, to fully understand the matter, a population growing so fast that there had been to 1880 more than 90 per cent added to the sum of inhabitants in 1870, and that gave, in the shape of farmers, a fixed and settled character to what had before been a quasi nomadic population, composed of men on horseback and women to whom one part of the Southwest was as good a place to live in as another. The permanent farmers, who were fenced within the heart of great pastures, and the communistic nesters, who were fenced out of the pasture lands of bygone years, cried aloud for relief, and got none. They could not get it from the stockholders of Paris and New York, or from the agents of these persons in the pastures."

The Sky Colors.

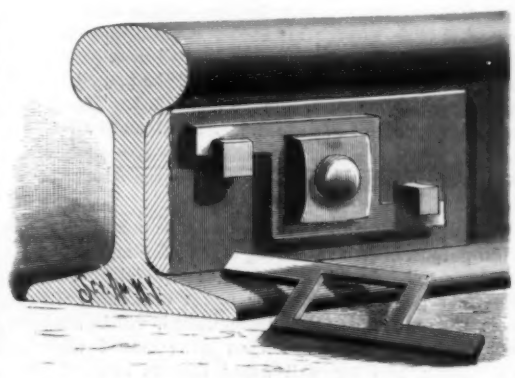
Mr. R. A Proctor, in a letter to the *Tribune*, says: The strange sunsets and sunrises, with long lasting ruddy twilights, green and blue sun, and strangely tinted moon, continue deservedly to attract attention. The strangest thing of all is that they continue still to be seen. They began in September, and now as I write—late in January—I see after sunset a red glare reaching to the northern horizon. Consider what this means. For the northern skies to be reddened in this way after sunset, the region of dust, or whatever else it may be which is illuminated with ruddy light, must be at least twenty miles above the earth's surface.

I have nothing to add to the various suggestions which have been offered, except to note that if the whole earth has been peppered with volcanic dust from Krakatoa, the evidence respecting meteoric dust, on which the views recently accepted have been chiefly based, must be reconsidered. For it becomes clear that one large volcanic outburst can do more to bring matter simulating the appearance of meteor dust to the earth's surface than would suffice for fifty years of meteoric supply as hitherto calculated. The smaller volcanic explosions taking place every year would, therefore, quite easily account for every particle of supposed meteoric dust hitherto collected.

IMPROVED NUT LOCK.

An invention recently patented by Mr. John W. Haley, of North Hartland, Vermont, is represented in the accompanying engraving. The fish plate, against which the nut rests, is provided with two hook lugs—one to the left of the upper corner of the nut, and the other to the right of the lower corner. The lower lug has a downwardly projecting prong, and the upper an upwardly projecting prong. A metal frame fits closely on the nut, and is furnished with two lugs, at diagonally opposite corners, extending in opposite directions, and which fit in the notches formed in the hook lugs.

The nut, which is secured on the bolt passing through the fish plates and rail, is drawn up tight, the frame is passed over it, and then the nut is turned back or loosened, until the

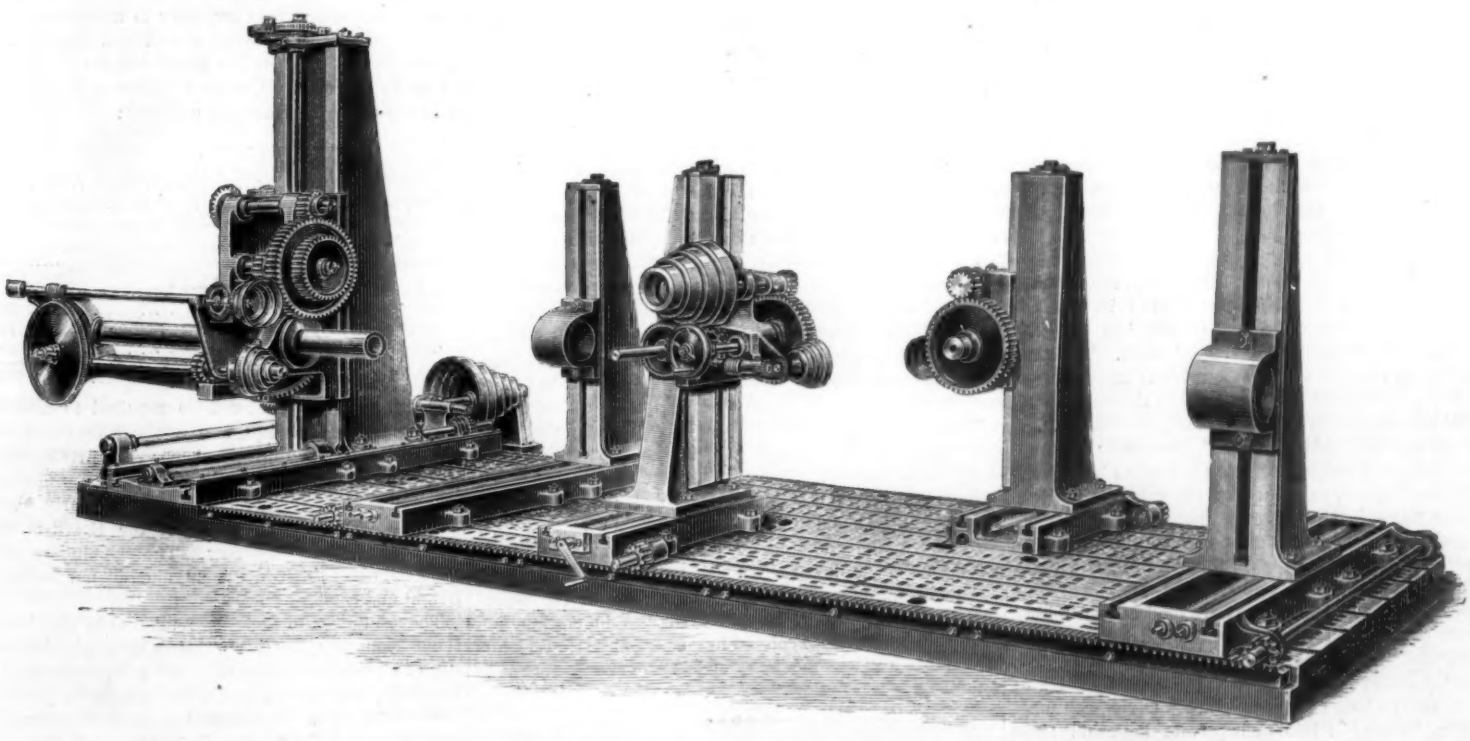


HALEY'S IMPROVED NUT LOCK.

lugs on the frame pass into the notches formed by the hook lugs. The nut is thus held securely in place against all jarring, and cannot be removed until it is turned forward sufficiently to permit the removal of the frame.

BORING, DRILLING, AND SURFACING MACHINE.

We illustrate a horizontal boring, drilling, and surfacing machine, constructed, says *Engineering*, by Mr. W. Asquith, of Highroad Well Works, Halifax, for an engineering firm in the United States. The main standard carrying the steel boring spindle, which is 6 in. in diameter, is adjustable vertically and transversely both by hand and power. The spindle is capable of variable feed in either direction, and can be made stationary for surfacing. It can also be withdrawn instantly from the work when required. The two standards which carry the bearings for the boring bars are adjustable in any direction by hand. There also two portable standards carrying boring heads. These have self-acting feed motions, and are designed for drilling or boring objects simultaneously with the main boring spindle. The whole apparatus is mounted on a strong cast iron bed plate, 24 ft. long by 8 ft. wide, accurately planed on the face, sides, and slots, and weighs 25 tons.



IMPROVED HORIZONTAL BORING, DRILLING, AND SURFACING MACHINE.

Stretching of the Brooklyn Bridge Railway Cable.

The strain upon the bridge cable in pulling the cars has had the result of stretching it gradually, until last week it was more than 100 feet longer than when the cars were first started. Early on Sunday morning a gang of men from the Trenton manufactory, where the cable was constructed, shortened it, under the supervision of the bridge engineer. A piece of the cable 30 feet long was cut out, and then it was respliced in time to draw the cars as usual in the morning.

Sugar Refining in Cuba.

The first sugar refinery ever established on this island, and which is now in course of construction in Cardenas, will soon be ready to begin work. According to a pamphlet issued by the company, the refinery will cost $313,258, while the capital provided for the construction amounts to $360,000. The establishment will refine 40,000 kilogrammes of sugar daily, or about 1,000 tons monthly, and will, therefore, allowing for two months of intermission every year, produce 10,000 tons yearly, which represents about one-sixth of the sugar consumed on the island. Should the Cuban consumers fail to favor the new enterprise, the company contend that the low price at which they can offer their product in view of the perfected machinery will be such that Spain and other countries using refined sugars will find it to their advantage to buy it of the Cardenas refinery.

In Favor of the Cable System.

The Rapid Transit Commissioners of New York have passed a resolution declaring that at present they considered the cable system of construction upon the new routes the most desirable, whether wholly or in part upon the surface. Although no designation has as yet been made, it is intended that none of the routes shall have elevated structures, with the exception of three, and it is a foregone conclusion among the members of the commission, that the fare on the new roads (26 in number) shall not exceed five cents.

An Elephant-shaped Hotel.

A hotel modeled after an elephant is to be shortly erected on Coney Island. The dimensions of the hotel are as follows:

The height will be 122 feet to the top of the dome; length, 150 feet; length of body, 80 feet; circumference, 168 feet. The head is to be 48 feet long and 132 feet in circumference; the neck will be 10 feet long, with a circumference of 108 feet; the legs will be 40 feet long by 60 feet in circumference; the ears will be 34 feet long by 20 feet wide; the tail 50 feet long, diameter 11 feet, tapering to 16 inches; the trunk 52 feet long, diameter 14 feet, tapering to 3 feet 4 inches; the tusks 32 feet long and 6 feet in diameter, tapering to 1 inch.

The eyes, 4 feet in diameter, will contain large lenses, through which, by the aid of other optical apparatus, objects at Sandy Hook may be distinctly seen. The elephant will face the ocean. The entrance and exit are to be through the hind feet. The forelegs and trough, out of which the elephant will be eating, will be occupied as bazaars.

The saddle bags are to be 16 feet long, and will contain two rooms outside of the body. The main hall in the body of the elephant is to be 80 feet long by 33 feet 4 inches wide. The room in the head is to be 48 by 78 feet. The dimensions of the two side body saloons will be 44 feet by 10 feet. There will be two thigh rooms, 28 by 10 feet; two shoulder rooms, 22 by 10 feet; two cheek rooms, 32 by 10 feet; one throat room, 32 by 8 feet; and one stomach room, 56 by 22 feet. This latter is to be a grand saloon. There will be four foot rooms, 12 feet 8 inches by 12 feet 8 inches; six leg rooms, 12 feet 8 inches long by 12 feet 8 inches high and 12 feet wide.

A gallery extending out from and encircling the body of the elephant will be 270 feet long. In this gallery there will be two side rooms, 42 feet long by 10 feet wide each. There will be two hip rooms, 28 by 10 feet.

The trough room, into which the trunk protrudes, is circular, 11 feet in diameter by 11 feet high.

Mortality in New York City.

By report of the Registrar of Vital Statistics for the year the total number of deaths in New York was 33,982—3,942 less than for the preceding year. The causes of death as summed up and classified by the Registrar for the last two years were as follows:

	1882.	1883.
Small pox	259	12
Measles	913	716
Scarlatina	2,060	743
Diphtheria	1,525	909
Membranous croup	729	640
Whooping cough	658	327
Erysipelas	149	173
Typhus fever	65	15
Typhoid fever	362	470
Cerebro-spinal fever	238	522
Puerperal diseases	407	406
Remittent, typho, malarial, etc	540	227
Diarrhœal diseases of children	3,479	2,867
Diarrhœal diseases, all ages	4,050	3,390
Alcoholism	223	218
Rheumatism and gout	184	154
Cancer	731	673
Phthisis pulmonalis	5,251	5,260
Bronchitis	1,583	1,428
Pneumonia	3,470	3,158
Heart diseases	1,474	1,690
Marasmus, scrofula, etc	928	825
Hydrocephelus and meningitis	639	557
Meningitis and encephalitis	741	671
Convulsions	635	516
Sunstroke	103	83
Brain and nervous system	2,971	2,712
Apoplexy	616	524
Peritonitis and gastritis	937	871
Bright's disease	1,856	1,845
Suicide	199	158
Drowning	207	249
Deaths by violence	1,376	1,325
Total zymotic diseases	13,429	9,252
Total constitutional diseases	7,894	7,419
Total local diseases	14,130	13,681
Total development diseases	2,179	2,115
Total deaths from all causes	37,934	33,982
DEATH BY AGES.		
Persons seventy years and over	2,398	2,333
Children under one year	9,867	8,724
Children under two years	13,469	11,266
Children under five years	17,530	13,770

Rendering Cheese Digestible.

A writing signing himself "Sea Cook" refers in the *Nautical Magazine* (London) to a lecture by Professor Williams before the Society of Arts, on the comparative nutriment of different foods, and he follows with a receipt of his own for restoring a chemical quality in cheese of which it is deprived in the ordinary mode of manufacture.

Any one, says the writer, who is able to find a substitute for salt junk is a benefactor to our seamen, and it would appear that such a benefactor has arisen in the person of Mr. W. Mattieu Williams, F.C.S. The substitute is cheese. Not cheese eaten as it is purchased, but cheese to which has been restored the proper amount of the salts of potass necessary to convert it into nutritious and digestible food. It is well known that the chief reason why salt meat is unwholesome and not nutritious is that the salts of potass have been driven out of it in the pickling. It is now known that one reason why cheese is indigestible is because the salts of potass originally in milk are absent from cheese.

As regards the relative nutriment in meat and cheese, the Professor tells us that—

"Taking the composition of a whole skinned and prepared sheep or ox as it hangs in a butcher's shop, the amount of nutriment in it is about equal to one-third of its weight of cheese. The fat is about the same in both, but the difference is due to the bones and excess of water. Thus 20 pounds of cheese contains as much nutritious material as a sheep of 60 pounds weight, and would have the same value as practical nutriment of it could be as easily digested. . . . Cheese is the most portable of all food, even more so than wheat, on account of the greater value in a given bulk."

Mr. Williams goes on to tell us that the common English or American cheese is the best for purposes of food. Here, then, we have in our midst the most valuable food to be obtained, and it is not used simply for the reason that owing to absence of salts of potass it is indigestible. Make it digestible by restoring the potass, and we have food for our toiling millions on shore, and for those at sea a food which will go far to not only nourish the consumer, but to make him proof against scurvy as well.

Here is the recipe, and "Sea Cook" advises all master mariners to copy it into their private logs, and those who are landsmen to have a copy made for use in the kitchen. Cheese prepared as below is not only good and sufficient of itself for a meal with potatoes, rice, etc., but forms a most useful, digestible, and appetizing adjunct to the *menu* of even a "swell" dinner.

1. Cut the cheese into shreds, or grate it, or chop it up fine like suet.

2. To every pound of cheese thus treated add quarter of an ounce of bicarbonate of potass.*

3. Put the mixture of cheese and bicarbonate of potass into a saucepan with either three times its bulk of cold water or four times its bulk of cold milk, and mix well.

4. Put the saucepan on the fire and bring the mixture slowly to the boiling point, taking care to stir it all the time.

5. Having got it to boil, keep it hot until the cheese is melted, which does not take long.

6. Turn it out into a dish, and the result gives a beautiful nutritious mixture which thickens like a custard in cooling. This custard may be eaten with impunity even by those persons who would be ill after eating a piece of cheese the size of a nut, and is peculiarly adapted as food for all persons who work hard with either brain or muscle.

Fancy dishes may be made by the ship's cook in the following manner for the captain's and passengers' tables, *e. g.*, take the mixture of cheese and bicarbonate and water (or milk) given above, and add to it two eggs, white and yolk beaten up together, for every quarter of a pound of cheese in the mixture. Put into a dish or a series of little dishes (previously buttered), and bake till brown. This must be eaten with bread or biscuit. Another way is to make the mixture a little thinner by adding a little more milk or water, and to put it in a pie dish with slices of bread laid one over the other. The custard should be poured in cold and left for an hour to soak before it is baked. This dish is a great improvement on the ordinary bread and butter pudding.

* This as nearly as possible puts back into the cheese the amount of potass that was taken out of it in separating (by rennet) the curds in the original milk.

Luminous Paper.

This paper may with great advantage be used for various useful purposes, such as, among others, for match box labels, luggage labels, labels for bottles (especially for bottles containing poisons), labels for crates containing fragile goods, which, by being thus distinguished, will be rendered less liable to rough treatment when being moved about on dark nights; also for wall paper, designs blocked upon which may be highly ornamented, while such paper will be serviceable for lighting up to a useful extent passages and chambers, especially water closets and other places wherein only moderate light is required; for writing paper and envelopes, business, private, and Christmas cards, and for advertisements, and especially for railway coach tablets, which, affixed to the ceilings and backs of compartments, will serve the twofold purpose of producing prominent announcements and rendering the carriage sufficiently light to enable lamps to be dispensed with when passing through tunnels during the daytime.

The inventor uses what is known to chemists as "sulphide of calcium," taking care that it is of a quality that will, after exposure to light, remain (as seen in a dark place) luminous for a considerable time (say, for instance, a whole night). This is either sprinkled over the paper pulp when in the engine, mixing the pulp and powder (in proportions about one hundred pounds of luminous powder to one hundred and thirty pounds or paper in pulp form, containing as little water as possible to carry it through the drying cylinders) thoroughly by stirring, and the paper is then finished in the ordinary way of paper making; or, a paste is made by adding to the powder twice its weight of boiling water, allowing the mixture to stand for a period of about thirty-six hours, but stirring it at intervals during that period. The supernatant water is then poured off, and the product is a paste termed "luminous water paste." This luminous water paste is mixed with paper pulp, preferably in the condition known in the trade as "three-quarter stuff." Thus, to one hundred and eighty pounds of ordinary paper pulp in condition containing as little water as possible, and known as "three-quarter stuff," one hundred and forty pounds of luminous water paste are added. With these is mixed a small percentage of smalt or ultramarine, if white paper is desired, and the compound is stirred well in the engine. It is then run off and tub sized in the way usually practiced by paper makers, using size such as is ordinarily employed by them. When desired, the size is given a waterproof character by adding to it a small percentage of tannin or bichromate of ammonia or other waterproofing substance; but care must be taken to avoid introducing or leaving in the paper pulp any substances (such, for example, as acids) that will react on the sulphide of calcium, and thereby lessen or destroy its luminosity. The size ought to be neutral. All bleaching powder must be removed, and the quantity of alum employed should be as small as possible.

In carrying out the processes it is important that iron tools should not be employed. Wooden tools are suitable.

This invention may, besides being applied in the manufacture of white paper, be employed also in conjunction with colors to produce colored luminous papers; but colors containing lead and the heavy metals in general are not so suitable as other pigments.

Dried Apricots.

California fruit growers have discovered that apricots bleached with sulphur fumes and then dried in the sun are superior to those that are dried in any other manner, or that are canned. They regard this fact of very great importance to the whole State. It enables every fruit culturist, however limited his means, and however small the product of his orchards, to dry his own fruit for market, and makes him independent of the canning factories. It is also stated that fruit can be prepared in this manner more cheaply than in any other, that its weight is better preserved, and that it is of superior flavor.

Large dealers in dried fruit say that the market for such products of California orchards will always be greater than the supply can possibly be. The United States alone will readily take all the fruit of the kind and quality now being produced by the sun-drying process that California can ever raise. Many thousands of apricot trees have been planted within a recent date in orchard form in southern California. Sun-dried apricots are being sold to California dealers at double the price paid for the best raisins.

Government Heavy Ordnance.

The report of the Ordnance Foundry Board, covering the conclusions arrived at from the investigations of the past year, has but recently been made. The board was required by Congress to answer the following questions:

1. "Which of the navy yards or arsenals owned by the Government has the best location and is best adapted for the establishment of a Government foundry?"

2. "What other method, if any (apart from the establishment of a Government foundry), should be adopted for the manufacture of heavy ordnance adapted to modern warfare for the use of the Army and Navy of the United States?"

3. "The cost of all buildings, tools, and implements necessary to be used in the manufacture thereof, including the cost of a steam hammer, or apparatus of sufficient size for the manufacture of the heaviest guns."

The Board recommend separate gun factories for the Army and the Navy, the former to be at the Watervliet Arsenal, West Troy, N. Y., and the latter at the Washington Navy Yard. The Board, however, does not recommend the establishment of a Government gun foundry complete, but rather that it "should establish on its own territory a plant for the fabrication of cannon, and should contract with private parties to such amounts as would enable them to supply from the private industries of the country the forged and tempered material," *i. e.*, "the Government should give contracts of sufficient magnitude to enable the steel workers of the country to supply the finished guns without its direct aid," while the Government establishments should be general finishing shops and "assembling" factories. In this connection the view is put forth that the Government should provide itself with factory facilities on a sufficient scale to perform the work of establishing standards, making experimental guns, and fabricating cannon on a moderate scale; but it is not considered judicious to concentrate in the Government establishments all the work of fabrication, or to include within their operations the preparation of such material as can be provided by the private industries of the country. As proposed, it is thought the purchase of the steel required for cannon will stimulate our own manufacturers and interest them in the operations of the Government.

At present, in the opinion of the Board, the steel manufacturers of our country are not prepared to produce the material required for the larger calibers, and the important question arises, What means shall be adopted to induce them to study the subject, and embark in the manufacture on a large scale? They cannot be expected to do this at a sacrifice of their own interests. This object can only be achieved by holding out a fair prospect of ultimate remuneration for the expenditures necessary to undertake the work, and this can only be done by the action of Congress.

As to the cost of plant for producing the tempered parts of guns up to 1,000 tons, ready for delivery at gun foundry, the Board make the following estimate:

Casting	$250,000
Forging (hydraulic press)	150,000
Rough boring and turning	210,000
Tempering	50,000
Total	$660,000
Additional cost if liquid compression be adopted	175,000
Approximate cost of plant for gun factories:	
Guns up to 6 inch caliber	$50,000
Guns from 6 to 12 inch caliber	150,000
Buildings and shrinking pot	350,000
Total	$550,000

Three years, it is said, will be required to complete the tools, construct the shops, and establish the plant. Such a factory will be able to turn out, per year, fifty 6 inch, seventeen 12 inch, and twelve 16 inch guns, or a proportionately larger number of smaller calibers, at a yearly expense of about $2,000,000. These figures the Board is confident closely approximate accuracy. The calculations are based upon estimates obtained abroad, and do not include ocean freight and customs dues.

Though the act of Congress replied to in the above report is one of inquiry, the Board desires to emphasize the necessity of a proper encouragement of the private steel manufacturers, which shall insure the supply of gun material without loss to the Government or private companies; and is of opinion if Congress shall be pleased to appropriate an adequate sum for providing modern artillery for the Army and Navy, to be held in the Treasury to be expended under the authority of the President, that (with such a prospect of remuneration) there are steel manufacturers in the United States who will undertake the production of gun metal on a large scale on the sole condition that their steel shall meet the required tests.

The Proposed Five-Year Limitation.

A boyhood acquaintance of Speaker Carlisle has written to that gentleman a forcible protest against the passage of the bill now before the House, limiting the duration of patents to five years. He relates to the Speaker an incident of an inventor in his neighborhood who had been working six years at an invention, but who, when asked what he should do if the law passed, replied, "I would throw these traps to the dogs and go fishing."

Correspondence.

The Rights of Inventors and the Policy of the Patent Law.

To the Editor of the Scientific American:

The main cause of difference between the civilized man and the savage is, one labors to till the soil as a foundation for civilization, and the other does not. One has tools and machinery to work with, the other has not. Tools and machinery render our present civilization possible. Take away permanently all the tools and machinery of civilization from the world, and civilization would have to cease.

All the tools and machinery that exist have been invented by somebody. Invention is simply adapting means to ends to render man's life on earth easier and more comfortable. Two centuries of labor, by the aid of tools and machinery, have made this country what it is to-day. The savage without tools for ages had done nothing to break the wilderness. Now, if our life as a nation is any better or more comfortable than that of the red man before us, we may as well thank the inventors of the world for the tools which have enabled us to go as high up as we are. Stop invention to-day, and the world will go no higher than our present inventions will allow us to go.

The right of the individual to what he produces or obtains by his labor is recognized by law, and protected; but if a man is foolish enough to spend his time and means, and go through poverty and self-denial to give a machine, or a convenience, or composition of matter to the world, which it never had before to use, and which will give civilization a higher plane of life, he is not protected as an inventor, and as a matter of justice to him, but on the principle that the patent law is based upon—that of good policy on the part of the public to offer him a patent for a limited time—17 years—and then his ownership ceases, and the great public own it. During this brief protection what is his condition? If a man steals a horse, the State attorney stands ready to prosecute, and the court casts him into prison at the State expense. But let a man steal an invention, and it is only an infringement, and you may get damages enough to pay your lawyer, and perhaps not. I suppose horses are of more consequence than inventors or their machines.

The patent law is based on public policy, not on justice to the inventor. It is said that an invention is a monopoly, but it does not monopolize anything the world has had before. It does not make a corner in breadstuffs, and oppress the millions, or raise the price of anything men have already; but invention cheapens the things we already have. An invention is not corn or wheat, that the public must have, and the public won't buy unless convinced they are the gainers by so doing. If an invention is held too high in price the public won't buy, so nobody is hurt but the inventor.

The bill lately passed by the House of Representatives seeks to shield the buyer of a patented article from liability to the inventor for royalty or damages. The innocent buyer of a stolen horse has no redress when the rightful owner takes his horse. It is safe to presume, on the part of the buyer, that a new and improved article is patented, and the purchaser should act accordingly, and buy of the rightful owners. If we have no sense of justice to the inventor, I do not believe we can afford to commit suicide by curtailing the limited protection at present thrown around inventions, and stay the progress of civilization and improvement. I do not believe the majority of people of the United States are in favor of any such movement. Let the people be heard.

A. F. ANDREWS.

Avon, Conn., February 16, 1884.

On Infringements of Patents.

To the Editor of the Scientific American:

I see by your valuable journal that you condemn the bills now before Congress altering or amending the patent laws. That shows that you are fully alive to the interests of inventors and patentees, for if the bills referred to become law, patentees may throw their patents into the fire, for they will be of no more value then than so much waste paper.

The plea that these bills are intended to protect innocent purchasers is too thin, for the *Gazette* records of the Patent Office are to be found almost everywhere, and persons who are anxious to avoid being swindled can get sufficient information from the records, and from other available sources, to guide them in their purchases; and if people get swindled, the best way in my opinion to put an end to that sort of business would be to authorize the Commissioner of Patents to keep a *patentees' register* in his office, in which patentees or owners of patents could, by paying the Commissioner proper fees, get the names of their attorneys and agents registered, including the proper address of all such; and it should be made a rule that no attorney or agent should be permitted to act as such until he had first obtained, from the Commissioner of Patents, a certified copy under seal of the authority filed in the Patent Office by the owner of the patent; and it should be made a law or rule, also, that any person who should attempt to sell patented articles, without having in his possession a certified copy of the authority of the owner, should be liable to arrest and fine. If some such amendment as this could be made to the patent laws, ample protection would be given to the public against swindling dealers in articles covered by a patent, and there would be no need of the dubious bills now before Congress.

The keeping of such a register as I have named would only entail a little extra work on the Patent Office, for which the fees to be collected would more than make up, for they would largely increase the revenues of the Patent Office for all time to come.

I have more than one invention of my own, for which I intended to ask you to apply for patents for me without delay. To these I have given much valuable time, but if Congress is going to tamper with the patent laws, as it is threatening to do, then I shall not apply for patents in this country, but send my inventions to England, believing that the new patent law of that country offers now superior inducements to inventors and patentees. H. F. ROSS.

San Francisco, Feb. 10, 1884.

[It must not be forgotten there are stringent laws now in force, State and Federal, for the severe punishment of any person who practices any kind of fraud or misrepresentation, whether in respect to patents, other personal property, real estate, etc. Those who, like some of the Congress members, aim to destroy property in patents because they fancy that somebody is cheated by patent rogues, ought to go a step further and pass laws to depreciate the holding of real estate because there are so many real estate knaves.—EDS.]

How to Obtain Pure Water.

To the Editor of the Scientific American:

Let the first water of a shower waste till roof is washed off, then catch a 20 gallon stone jar full and cover it up for twenty-four hours, then carefully dip it out and place in another jar in the cellar, all but a few inches in the bottom, which will contain all the impurities any filter will extract. This can be easily washed out, and the jar is ready to use again.

The jars impart no taste to the water, and do not leak. This is sufficient water for a family of five to drink from. Well water used for tea and coffee is purified by boiling.

Most so-called filters depend on gravity to force particles of water past particles of impurity, while the latter are supposed to be held mechanically by a strainer composed of various substances, while my dependence is simply a clean vessel and the force of gravity to get rid of the impurities. As the impurities continue to settle and we use the water off the top, we get the purest kind of a drink—clear and sparkling. The purity of the water that passes through most filters, ever after the first shower has left its filth, is questionable, as the impurities are not gotten rid of, but accumulate to befoul the passage for the next water that comes.

My arrangement requires no more attention than any filter should have, and may be modified to suit one's convenience or ideas. Only use clean vessels and let the water settle. To get a cold drink in summer, hang a jugful in the well. F. W. BURR.

La Fox, Illinois, February, 1884.

The Foucault Experiment.

To the Editor of the Scientific American:

In your issue of January 12, one of your correspondents, referring to the Foucault experiment with the pendulum, which is said to prove the axial motion of the earth, expressed a great desire to have the experiment repeated in Washington. I sincerely hope a committee of scientific men will take the matter up, and test the experiment thoroughly, and demonstrate beyond dispute the truth or falsity of it. Because, aside from the pendulum experiment, we have no *direct, palpable* proof of the axial motion of the earth.

Quite recently a number of scientific gentlemen in Great Britain and some of the public journals asserted the Foucault experiment false, coming to that conclusion after repeated tests of their own. In many cases the experiments have shown *no change* at all in the plane of oscillation of the pendulum; in others the alteration in the plane of vibration has been in the *wrong direction*, and very often the *rate* of *variation* has been altogether different to that which theory indicated. The Liverpool *Journal* states that a scientific gentleman in Dundee tried the pendulum experiment, and said that, as far as proving the axial motion of the earth was concerned, it was a gross delusion; but that it tends to the *magnetic meridian* he found to be a fact. The Manchester *Examiner* also reports an experiment by the Rev. H. H. Jones, F.R.A.S., in the Library Hall of the Manchester Athenæum, in which the rate of variation was *entirely different* to the accepted theory. Did space permit I could give particulars of several other experiments with like results. Now, in the face of all this, I agree with your correspondent, that a thorough test of the Foucault experiment ought to be made in Washington to prove the truth or falsity of it.

I would also suggest that two pendulums be used, one of metal the same as Foucault's, another of wooden rods pinned and glued together and glass ball, or constructed of some perfect non-nonductors of electric and magnetic currents. A cord would not answer, as the torsion might cause the pendulum to vibrate with a circular motion; the point of suspension ought also to be non-conducting, resting on a glass bearing. My idea for having one pendulum a perfect non-conductor is, that if a metal one is affected by electric currents or the magnetic meridian, the other would not be. Then if the two pendulums continued their oscillations in exactly the same plane, I think it would prove that electric or magnetic currents had no influence on the direction of their vibrations. In starting the pendulum great care is required to avoid giving any bias from the true plane of vibration. In the experiments referred to, a thread having a loop at one end was passed over the pointer on the under side of the ball, the pendulum drawn back and tied. When perfectly at rest the thread was burned apart, and the pendulum started on its course, the loop falling off. I would like to see immediate steps taken for a thorough practical test of this celebrated experiment.

WILMER SMITH.

Goderich, Ontario, February 18, 1884.

Some Curious Facts about Snakes.

Catherine C. Hopley, who has written a great deal on snakes and their habits, came to America from England last summer with the intention of obtaining, if possible, some new facts and illustrations of snake life. She writes to *Land and Water* that one object of her ambition was to procure for one of the museums a mother snake with her brood refuged in her throat; but, though hitherto unsuccessful, she has reasonable hopes that a thus refuged family of little ophidians will be furnished to more than one of the national museums next summer, enthusiasts promising that no efforts shall be wanting to afford ocular proof of this maternal instinct. That it should still be doubted anywhere arouses the ire of many in America, she adds, who have for years been offering testimony as eye-witnesses. What is now desired is that observations should be extended to Africa, India, and Australia; because if the habit of a mother snake receiving her young into her throat for refuge should be confined to this continent only and to England, it is a remarkable feature in ophidian history for the most learned biologists to work out.

But, as regards Australia, some few cases are not wanting. A gentleman, who is a great traveler, an ardent sportsman, assured the writer that he had himself seen an alarmed black snake (probably *Pseudechis porphyriacus*) open her mouth and thus receive her young. On shooting her, the young ones escaped from the mouth again.

A gentleman who writes in the *American Field*, under the name of "Snipe," described "a dark colored snake of about six feet long," opening its mouth and receiving its young. Watching for reed birds—the "Bob o' Link" of the Eastern States, and the "rice bunting" of the South—he was lying flat on the ground with his gun, in the latter part of August, when about ten feet off he saw the snake with her mouth wide open, and the young ones hurrying in as if eager to hide themselves. He watched her for some minutes, when his friend who was shooting with him came near and disturbed the snake, which then began to move off with the hidden snakelings, while a number of little brother and sister snakes, "not yet taken in" followed closely. "Snipe" then took aim and shot off its head, and on opening the snake found the young ones all alive, coiled in a ball near the throat; while further down were a bird and a meadow mouse, recently swallowed. He relates the incident in opposition to the hypothesis that snakes, being cannibals, might swallow their young for food, and describes this mother as patiently waiting with her mouth open, all action being confined to the eager young ones.

Apparatus for Producing a very Low Temperature continuously.

Cailletet has constructed a continuous apparatus for producing intense cold, which consists of a closed steel cylinder in which is a coil of copper pipe which projects from each end of the cylinder. Two copper tubes are also screwed into the cylinder, and one of these communicates with the mercurial piston pump already used by Cailletet, while the other receives the ethylene which has been compressed by the pump and cooled by methyl chloride. By this arrangement he forms a circuit in which the same quantity of condensed ethylene is repeatedly evaporated in the copper coil, producing intense cold, and then compressed again by the pump being sufficiently cooled with methyl chloride and ready for evaporation again. This process goes on as long as the sucking and compressing pumps are working—*Compt. Rendus*, p. 1115.

The Panama Canal.

Rear Admiral Ammen, who is well informed on such matters, says that, whatever they may say to the contrary, all that they are doing at Panama looks to the construction of a canal that must have 124 feet lockage, and will then cost $200,000,000, in addition to the $100,000,000 called in on stock or obtained on bonds. About $20,000,000 has gone to the founders and sub-founders; about as much more for the purchase of the Panama Railroad, and 10 per cent in advertising and extra fees to bankers; and as much more to contractors as a bonus. I have from an engineer, conversant with the work, that every cubic meter of hard ground excavated costs $2.50, which is five times what it should cost, even there. But the difficulty, even for a lock canal, is to get rid of the excavated material. An enormous amount of excavation will be required to get proper slopes in the Culebra cut. This is almost wholly in earth, and the summit level of the railroad is a mere "hog's back"—that is to say, it has very steep grades on both sides. The cut was made only 25 feet deep, because of the tendency of the earth to slide. In fact, a train was caught in this gap by a slide, and it required days to dig it out. The earth had to be carried off in buckets, and it was like putty. If the canal has a lockage of 125 feet, then the deep cut will be at least 200 feet. So you see what a cut in width it must be, and what the land slides will be after heavy rains.

The Dwarf Trees of China.

The dwarf trees of China are curiosities of forestry. Every child knows how the Chinese cramp their women's feet by bandaging them when they are infants, and thus render it impossible for them to walk. It is, however, wonderful to see miniature oaks, chestnuts, pines, and cedars growing in flower-pots, fifty years old and yet not a foot high. To do this take a young plant, cut off its tap-root; and place it in a basin in which there is good soil kept well watered. If it grows too rapidly, dig down and shorten in several roots. Every year the leaves grow smaller, and the little dwarf trees make interesting pets, just as some people raise canary birds, and others squirrels.—*Cultivator.*

Porpoises and Salmon.

From good authority we learn that the porpoises are the worst enemies the salmon of the lower St. Lawrence have. They cruise off the mouths of the tributary salmon rivers, and when the salmon are running in, from about the middle of June to August, the shore is alive with them, feeding on the salmon. "We always know pretty nearly," says the writer, "when the salmon will strike in by the presence of the porpoises, which have followed them in from the ocean."

DREDGER ON THE TANCARVILLE CANAL.

It is now a long time since the idea was put into practice of employing artificial means of transportation for removing the debris in excavating. At Suez the dredges, in order that they might be kept constantly running, employed a number of trains of earth cars for this purpose.

These different attempts, for the most part vain, or at least unsatisfactory, have caused our engineers and contractors to give up the idea of continuing this method of removal of rubbish.

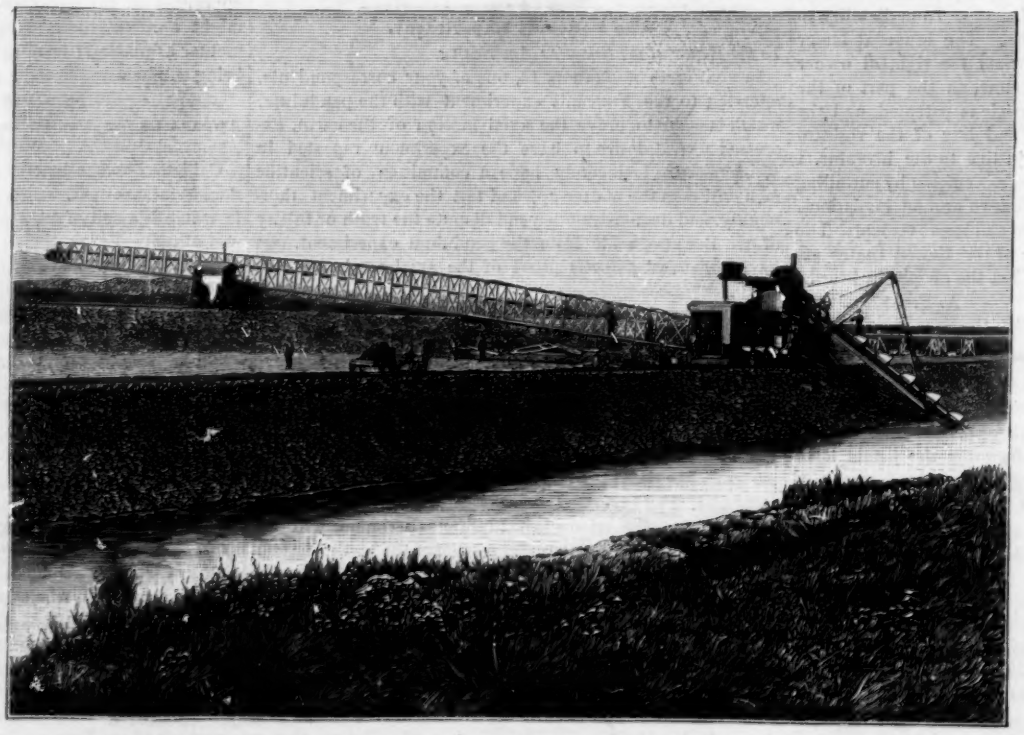
The device for transporting rubbish, which has this year put in its appearance in our large works of excavating, consists of a long metal frame resting upon two cars which are movable along railroad tracks. This frame supports two series of rollers upon which rests the endless carrier, made of rubber and cotton tissue. It is this carrier, of one meter in width, that receives the rubbish as it falls directly from the buckets of the dredge and transports it, by its constant movement, to a distance. The frame being about 60 meters in length, requires a carrier of 124 meters. The carrier travels at the rate of about two meters a second, and is moved by two small vertical engines located on the cars which support the framework and give a rotary motion to the two end rollers, which have a circumference of about one meter, while the other rollers are only about one-third as large, and in order to afford a continuous support to the carrier filled with rubbish, are located only one meter apart.

The dredger, raising about 1,800 to 2,000 cubic meters of matter a day, is readily cleared by the carriers, and at the outer extremity of the frame is seen a bank equal in size to the trench of the canal.

The carrier is able to work up or down hill, according to the nature of the country. If the depositing bed is lower than the point under excavation, the power required to operate the carrier is very slight, the weight of the load alone actuating the carrier; in the other case, however, considerable power will be needed.

If, now, we could go back several years and compare the methods employed at that time with the system we have just been considering, now in operation on the canal between Havre and Tancarville, we should be filled with astonishment. There, where thousands of men used themselves up in the work of years, science flew to their assistance, and now we find nature transformed as if by enchantment by the will of man. Yesterday, indeed, that grand Frenchman, De Lesseps, who is to be found wherever there is any great work to be done, said with that jovial good humor which is one of his characteristics, "If a mountain stands in our way, we pick it up and cast it to one side." To-morrow, perhaps, we shall behold a way opened up to the desert, even as we have seen the bold attack of four of these carrier dredges working together in the canal of Havre and Tancarville, struggling powerfully and yielding to no obstacle that may be in the way. Scarcely a hundred men are now employed where formerly thousands would have hardly sufficed. The carrier dredge which we have illustrated will soon be employed in digging the trenches of the Panama Canal.—*La Nature.*

[An illustration of an American dredge built for Panama was given in the SCIENTIFIC AMERICAN of March 3, 1883.]



DREDGER AND CARRIER ON THE CANAL OF TANCARVILLE, FRANCE.

A NOVEL VELOCIPEDE.

The engraving represents a velocipede of the unicycle type, for which letters patent were recently granted to Mr. C. M. Schaffer, of Louisville, Ky. The wheel is made double, or with two sides, so that a space is formed between the sides for the rider. It is made of such a diameter that the operator may stand erect, and in order to obtain the necessary vertical space without too large a wheel, the rim is made of considerable width. With this wide tire the wheel will stand without support. The hubs are formed in

A NOVEL UNICYCLE.

two portions—the hub proper, which receives the spokes, and a disk provided with a crank pin—the two parts being held together by a bolt. The outer portion being turned down smaller, a space is formed for suspending the saddle frame, which forms a continuation of the axle and which extends down upon each side of the rider, the lower ends being united, thus forming a space in which the treadles are operated. Extending horizontally upon each side of the axles are arms whose ends are connected; on each arm is a handle which may be adjusted to suit the rider. The vertical portions of the saddle frame are made with dovetail flanges; the treadles have dovetail lugs that engage the flanges of the frame so as to slide therein. The saddle is suspended by rods from the rear horizontal arms. To allow of entering the machine a portion of one felly is made separate, and the hub is made with a hinged segment, to which the spokes from the felly segment connect, so that the latter can be swung out. The segment is held in place by latches, operated by a hand wheel at the inner side of the continuous felly. By this construction a light and substantial machine is obtained.

A Proposed Addition to Our Navy.

There is at present a bill before Congress which provides for the construction of seven steel vessels besides one ram, one cruising torpedo boat, and two harbor torpedo boats. Of the seven vessels two shall be cruisers (of 4,500 and 3,000 tons, respectively), one a dispatch vessel of 1,500 tons, two heavily armed gun boats of 1,500 tons each, and one gun boat not to exceed 900 tons, to be built on plans and specifications to be furnished by the Admiral of the Navy.

Drying Power of Calcium Chloride.

The affinity of deliquescent salts for water, and especially that of calcium chloride, is utilized in drying gases, in organic analysis for absorbing water, and for drying the air in desiccators. Fleischer has made some experiments with Lambrecht's hygrometer, and found that fused calcium chloride is less efficient than was generally supposed. He placed the hygrometer in a desiccator charged with calcium chloride. The air in the desiccator contained 62 per cent of moisture at the beginning of the experiment, and at the end of two hours it had fallen to 31 per cent, in two hours more to 25 per cent, and at the end of six hours to 21 per cent, where it remained stationary. In a second experiment, at the end of five hours it indicated 27 per cent.

When the desiccator was charged with sulphuric acid, 66° B., the moisture decreased from 67 to 30 per cent in 35 minutes. At the end of an hour it had fallen to 18, and in 105 minutes to 0·0 per cent, or absolute dryness.—*Zeitschrift Anal. Chemie.*

Steatite Gas Burners.

The following facts relative to the nature of steatite and its manufacture into gas burners are given in the *Civil-ingenieur.*

Steatite occurs either in detached masses or in thick layers, and varies in color from a white, through shades of blue, green, and yellow, to a brown.

The most important deposits of steatite in Europe are at Gopfersgrun, near Wunsiedel, in Bavaria.

There are legends which state that at one time this steatite was made into balls, burned, and used as projectiles.

In composition it is chiefly a silicate of magnesia. The following are analyses of the yellow and white varieties:

	Yellow.	White.
Silicic acid	59·80	62·91
Magnesia	36·04	33·51
Alumina	1·28	1·21
Iron oxide	0·31	0·12
Alkalies	0·21	0 17
Water (combined)	1·52	1·82
Water (hygroscopic)	0·84	0·26

The steatite burner manufactory of Lanboeck & Hilpert was established at Nuremberg in 1867, but was removed to Wunsiedel in 1871 in order to avoid the transportation of the raw material.

A force of fourteen miners is employed, and the steatite deposits are worked by means of a shaft, which at present is about 55 feet in depth. The quantity mined yearly is 5,000 hundredweight of the white and yellow varieties.

Steatite is especially suitable for gas burners, since by burning it becomes very hard, and is not affected by heat—properties which are of great importance where exactness and uniformity are desired.

The steatite comes from the mine in pieces the size of a man's fist and smaller. It is first cut into plates whose thickness corresponds with the height of the burner. The burners are then cut out and turned on a lathe, after which they are placed in crucibles with sawdust and moderately heated. This process gives the steatite a slight degree of hardness, which is necessary in order to obtain slits and holes of exact dimensions. The burners are then cut or bored as desired, and subsequently subjected to a strong white heat in muffles. This changes the black color resulting from the first firing to a light yellowish color, and makes the tips very hard.

For standardizing burners with regard to their consumption these are connected with the factory works for the manufacture of coal gas and oil gas.

The establishment employs about forty persons, and furnishes weekly from five to six hundred gross of burners, according to the kind. About three hundred kinds of burners are manufactured for coal gas and oil gas.

The waste from the factory, consisting of steatite powder and small pieces of the mineral, is sold for use in paper factories, tanneries, and terra-cotta works.

The German Tailors' Academy at Dresden.

This institution had, in 1883, 355 pupils of both sexes. Of these the majority were men who devoted themselves to learning how to cut men's clothing; 239 took this course. Ninety-two pupils of both sexes received instruction in cutting ladies' and children's dresses, and 24 in cutting underclothing.

The academy also offered instruction in commercial arithmetic and bookkeeping, and 98 pupils embraced the opportunity of learning these branches.

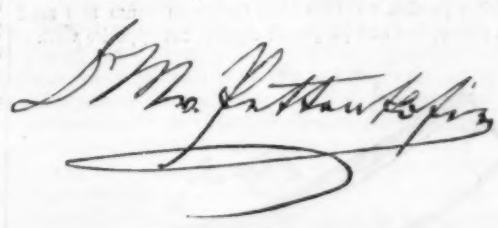
MAX VON PETTENKOFER.

Max von Pettenkofer, one of the greatest of German scientists, was born December 13, 1818, at Lichtenheim, near Neuburg on the Danube, in Bavaria; and received his earlier instructions in the village school, until he was taken to Munich by his uncle, the well known Court Apothecary, Franz Xavier Pettenkofer. After passing through the Latin School and the Lyceum in Munich, he studied pharmacy and medicine at the Munich University, and graduated in 1843 as Doctor of Medicine. As he had no great inclination for the occupation of a practical physician, and upon the advice of the chemist and mineralogist Von Fuchs, he devoted his time and attention to the study of chemistry. He studied in the laboratories of Professors Keiser, of Munich, Scherer in Wurzburg, and Liebig in Giessen. Upon his return to Munich in 1845, he was employed as an assistant in the Mint, and in 1847 was appointed extraordinary Professor of Medicine at the University of Munich. In 1850 he was appointed Superintendent of the Court Pharmacy, and in 1853 he was appointed regular professor. In 1856 he was elected a member of the Academy of Sciences.

In all his scientific works, Pettenkofer has endeavored to utilize practically the results of his scientific researches for improving the sanitary conditions of dwellings, hospitals, and other like institutions, and for benefiting mankind by the results of science. This is distinctly shown in his earlier works on the refining of gold, on platinum, the difference between German and English hydraulic limes, on heating by means of stoves and hot air, and the great invention of the manufacture of illuminating gas from wood. Pettenkofer is specially well known by his works on ventilation, his examinations in relation to respiration, for which he has constructed especial apparatus, and his researches and observations on cholera and its relation to the nature of the ground and the surface water; all of which are published in his work on Cholera, Munich, 1855, and in his report on the cholera epidemics of 1854 and 1865. Pettenkofer also invented a new method of preserving oil paintings, which has replaced all other methods heretofore used for this purpose.

Since the Bavarian Ministry has created a chair for hygiene in the University of Munich, and since 1865, at which time Pettenkofer was made Professor of Hygiene at Munich, he has devoted his time exclusively to hygiene and sanitary measures. The results of his scientific researches he has published in Liebig's and Woehl's "Annalen der Chemie," in Dingler's "Polytechnischen Journal," and other periodicals, and lately in the "Zeitschrift fur Biologie," which he has edited since 1865, with Professors Buhl, Radlkofer, and Veit, in Munich. He was an expert and authority on techno-chemical institutions, etc., and questions of sanitary supervision and police regulations, on which he has given some very valuable opinions, some of which have appeared in print.

The portrait given herewith is taken from an etching in *Nord und Sud*.



The Ancient Roman Bridge—Pont du Gard.

A correspondent of the Philadelphia *Ledger* writes from Nimes, France, as follows:

In your issue of December 12, I see that my fellow citizens are exercised on the question as to the erection of a stone bridge at Market Street or one of a lighter weight, and as I read I looked again at the ponderous structure I had crossed, which has stood here for 2,000 years, and wondered if Philadelphia could perpetrate the blunder again of a temporary bridge of wood or iron. Let me give some details of this superb structure, which is one of the most magnificent Roman remains yet in existence. It is formed of 3 tiers of arches, the lowest comprising 6, the middle 11, of equal size, and the upper 35. Above the highest tier is an aqueduct of about five feet in depth, roofed in with immense stones, which was formerly in use to convey water from a distance of 25 miles to Nimes.

The Pont du Gard is 160 feet high and 882 feet long. When this stupendous work was constructed is unknown; but it is conjectured to have been built by Agrippa, the son-in-law of Augustus, B. C. 19. Conceive the difference in economy between an erection of this sort and an iron bridge which must grow continually weaker. We have an example of an iron bridge conceived in sin and raised with iniquity, whose slender fabric needs an annual coat of paint, and whose rods, and nuts, and bolts will need piecemeal renewal if not entire replacement. In all this ancient structure, though eaten by the tooth of time, I could only find one crack, and that so slight as hardly to be visible. Why not, then, give us at Market Street a durable bridge that will need no paint to protect it or hide its weakness?

Can a great municipality like Philadelphia afford to put up another trifling bridge, involving it in annual repairs and early renewal? If there is a necessity of a more solid foundation than is easily found, by all means go deep enough to secure solidity and permanence, but do not repeat the mistake of Girard Avenue. The superb bridge of the Reading Railroad at the Falls, over which heavy trains pass almost momentarily, is another illustration, quite in the view of Philadelphians, as to the merit of a stone over an iron construction. And now that I have returned from my visit to the Pont du Gard, only fifteen miles distant, let me give some description also of the grand Roman amphitheater in the center of this city. It consists of two stories, each of 60 arcades, 70 feet high, the lower barricades serving as so many doors. There were originally 32 tiers of seats, and it is estimated that it would contain 22,000 to 25,000 persons. Wide corridors, both above and below, ran around the whole of the building. In the subterranean vaults and substructures were confined the wild animals, and directly opposite is the room where the bodies of the men slain in the gladiatorial combats were deposited until their burial or cremation. The vaults of the lower corridor or portico are like a vast natural cavern; the upper one is roofed with huge stone beams 18 feet long, reaching from side to side.

The amphitheater is built of limestone in immense blocks laid in courses with perfect regularity and without mortar. The passages all extend outward, thus admitting of a speedy evacuation of the amphitheater through its sixty vomitoriæ.

The building is an ellipse, the dimensions being 437 feet from east to west and 332 feet from north to south. As the sixty passages radiate at different angles, the ring stones of the immense arches would seem to be all different. Each part of the façade forms part of the ellipse, and therefore each of these stones needs to be cut to form part of the great arc. This edifice is therefore replete with varied interests. To the historian it speaks of that great nation which conquered "all the world;" the humanitarian, gazing into its arena, cannot but recall the gladiatorial combats it has witnessed; the architect and mechanic will regard it with most respectful interest; and for all it is an epic in stone.

THE production of the Lake Superior copper mines for 1883 was sixty million pounds of copper.

The Best Knowledge.

The knowledge which we crave and work for, which we look for and find, which we think out or dig out for ourselves, which we rejoice in as in a newly found treasure—that is the knowledge, be it small or great, that is worth having. It is like the food for which we hunger, it gives us fresh power and fuller life. It matters far less even *what* this knowledge is than the way in which it was gained.

The most systematic and well-prepared course of study, worried through by a student whose only care is that he may get his diploma, is of far less value to him or to the world than the vital thought of the young mechanic, who, anxious to master the secrets of his trade, patiently studies its details, discovers its principles, and infuses into it his own fresh and living force; perhaps in the form of some new invention, or perhaps in a more skillful touch or a more delicate finish than it has yet received.

Knowledge, like the blood, is only healthy while in brisk circulation. Its work is to supply the veins and arteries of our mental life, thus continually being transformed into new thought and fresh activity. It should feed our whole lives, making them richer, happier, more powerful, more valuable. The knowledge that does this has attained its object, whether it be the highest culture of the schools, or the practical business of the office or the factory; whether it be the latest results of scientific research, or the faithful observation of a single flower; whether it be the knowledge of human nature that enables a general to conduct a campaign, or that which helps a gentle woman to maintain harmony in her family.

At the best no one can know much. Compared with the infinite realms above and beyond us to be yet discovered, the knowledge of the most learned man covers but a tiny spot, and what fraction of such a spot ours may cover is but a small matter. But it does matter to ourselves and to all around us the use we shall make of what we do possess; whether we shall carry it around for exhibition, or whether we shall convert it into a living force, to elevate our own natures and to bless and help mankind.—*Phil. Ledger.*

Injurious Effects of Baking Powders.

A writer in the *Journal of the American Medical Association* avers that there is no doubt that baking powders, even the best of them, are damaging to health. He says:

To make the matter clear, it may be stated that the average baking powder is composed of bicarbonate of soda, cream tartar, and starch, with a possible admixture of other things. The continued use of even this purest baking powder will affect the system seriously, commencing with only a slight derangement of the digestive organs, which gradually becomes chronic, changing the secretions of the stomach necessary for digestion (muriatic acid); in fact, altering the whole chemistry of the human stomach.

The continued use of alkalies in any form injures the health. Look at the alkali country west of us, where the alkali is found in the *drinking water*. The same dangers will arise from the persistent alkaline medication of our *daily bread*. The various forms of dyspepsia, bladder troubles, Bright's disease, consumption—the newest researches speak about a wrong proportion of the alkalies in this disease—are only too often caused by this modern substitute for the old, time-honored, common sense practice of using yeast.

A New Form of Steel.

At a recent meeting of the Institution of Mechanical Engineers, London, the Hadfield Steel Foundry Company showed specimens of steel castings and pieces of steel wholly without magnetic capacity, including axes and other tools carrying a fine cutting edge, which were the subjects of very great interest to those present, for these cast tools require no treatment of any kind when they come from the mould. They are very hard, but what is the more remarkable is that they are very tough at the same time. They require no hardening or tempering. The steel of these remarkable properties is made by thoroughly incorporating, under Mr. Robert Hadfield's patent, from 7 to 12 per cent of rich ferro-manganese, containing about 80 per cent of manganese. The applications of this remarkable metal are, it need hardly be said, innumerable. Tools of almost every description can now go straight from foundry to grinding and finishing rooms, while for the numerous engineering purposes to which steel is applied, for strength, toughness, and hardness are now added.

The New Forth Bridge.

The most interesting structure at present in progress, says *Engineering*, is the Forth Bridge, the largest ever undertaken. It will consist of two spans of 1,700 feet, two of 675 feet, fourteen of 168 feet, and six of 50 feet, with a clear headway for navigation of 150 feet above high water of spring tides. The two large spans are two cantilevers, each 675 feet long, with a central girder 350 feet long, the depth of the cantilevers being 350 feet at the piers and 50 feet in the center. To hold aloft and to maintain the immense weight of steel of which the cantilevers and girder will be composed, piers will be required of corresponding magnitude. The central pier, on the island of Inchgarvie, will consist of four cylindrical masses of concrete and masonry, 45 feet in diameter at the top and 70 feet at the bottom. They will be founded on rock at a depth below high water varying from 24 feet to 70 feet, and will be carried up to 18 feet above high water. The length of the bridge will be more than a mile, and of the viaduct approaches 2,754 feet.

The contract has been let for £1,600,000. Considerable progress has been made with the masonry, about 17,000 cubic feet of granite masonry having been set, and the number of men employed will soon reach 800.

As it is intended to manufacture the steel superstructure of the bridge on the spot, very extensive works, lighted by electric lamps, have been constructed at Queensferry, and the plant provided includes about fifty steam engines of various classes, and a large number of specially designed hydraulic tools, drilling machines, and other tools for dealing with the 45,000 tons of steel which will be used in the bridge. The manufacture of the superstructure of the bridge will soon be commenced. All the important members subject to compression will be of a tubular form, as will have been gathered by those who read the paper on the subject read at Southampton in 1882, by Mr. Baker.

About three miles of steel tubes, ranging from 12 feet to 5 feet in diameter, and from 1¼ inches to ⅝ an inch in thickness, will be required. Plant, including gas and other furnaces, has been provided for this purpose. The steel plates are heated in gas furnaces, and stamped to a desired curvature in a 2,000 ton hydraulic press; the edges planed, and the plates temporarily clamped together to form a tube about 400 feet in length. Traveling drilling machines will then traverse the tube and drill all the holes required to rivet the plates together, but this riveting will not be done until the bridge is erecting, plate by plate, across the Forth. All the machinery required to begin the manufacture of the tubes in the new works has been designed by Mr. Arrol, one of the contractors.

How to Make Printers' Rollers.

The old formula of one pound of glue and one quart of molasses is the best. A first quality glue only should be used. Put the glue to soak over night, letting it take up all the water it can, until each and every piece is soft; then drain it thoroughly, after which place it in a kettle constructed upon the same principle as a regular glue kettle—the outer shell filled with water, the inner one the composition. Boil (we do not mean simmer) the glue until it is *all* melted, leaving no hard pieces, then add the molasses (the old fashioned New Orleans molasses is the best), and stir constantly for about three-quarters of an hour.

It is important that the roller mould should be well and thoroughly oiled, so that the roller, when cast, can be removed, which must be done steadily and without haste, else the face of the roller will be marred. Do not attempt to remove the roller from the mould in less than twenty-four hours. In warm weather use more glue in proportion to the molasses; in cold weather, *vice versa*. A roller made in this manner will last longer and do better work than any of the alleged patent compositions.

The roller being cast and successfully removed from the mould, should not be used for several days, until it is thoroughly surfaced.

To keep it always in good condition, it should not be cleaned either with kerosene or benzine, as they burn out the molasses, leaving an unyielding mass of glue, full of cracks and perfectly useless. Wash the roller in oil, wipe off with a rag, and you will have a roller that is always reliable.

Telephones as Watchmen's Tell-Tales.

"Farmers' and Mechanics' Bank O. K.," "Centennial Bank O. K." These messages, and announcements of a similar character from nearly every bank in the city of Philadelphia, came rushing into the telephone exchange at Fourth and Chestnut Streets one night lately at 10 o'clock, and for a few minutes the operators were kept busy receiving word from the watchmen who are locked up in the big financial institutions as to the condition of affairs behind the granite and iron walls.

As an additional police precaution against robbery, fire, or accident, during the past few years nearly every bank, large banking house, and several prominent business establishments have had their places connected by telephone with the exchange. Beginning at 7 o'clock in the evening and ending at 6 in the morning, the watchmen of these institutions communicate half-hourly with the operator at the exchange. At the appointed time, in case there is no report from a particular place, a man is sent to the bank or mercantile house to ascertain the cause for the failure. If the watchman does not answer the messenger, then the authorities are communicated with and the bank is opened. A failure to report is also marked on the slip in the exchange, and word is sent to the bank or mercantile house the next morning. This new method of policing has become popular.—*Electrical Review.*

A RECENT BOILER EXPLOSION AT CINCINNATI, OHIO.

At 1:30 P. M. of Saturday, the 19th of January, 1884, the right hand boiler of two used by the Cincinnati Corrugating Company exploded.

Both boilers were horizontal, two-flue, 44 in. in diameter and 22 ft. long. The left hand one was double riveted on the longitudinal seams, and was built of thicker iron than

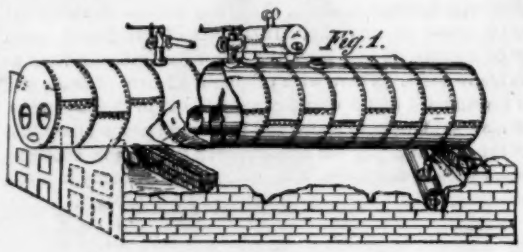


Fig. 1.

the exploded one, and by a different firm of boiler makers. The right hand boiler, which exploded, was single riveted, and contained shorter sheets, consequently more rings of plates. The boilers were connected by 9 in. necks to a common mud drum on the rear sheet, and to a common steam drum at the sixth and seventh seams. They were sustained on the cast iron fronts and the neck of the mud drums, having no stand at their centers.

Both boilers were put together with a steam riveter. The machine with which the right hand or exploded boiler was made strikes a direct blow of about 9 in. drop, and operates so fast that if a defect is discovered it cannot be stopped till several blows are struck; this would seem to be the primary cause of this explosion, as every fracture follows the line of

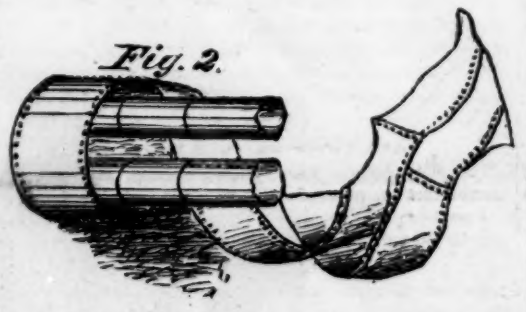


Fig. 2.

the rivets, leaving the end of each outer sheet on the under sheet, the upper sheet being the one subjected to the most torture in riveting by this process. Other steam, compressed air, and hydraulic riveters are in use, which do not torture the iron as much; the hydraulic, perhaps, is the best, as it presses the rivet home, and the pressure can be moderated instantly.

This boiler gave way first at the fourth sheet from the front end, just behind the bridge wall. The force of steam and the large body of water suddenly turning into steam drove the forward part forward on to a slight eminence till it struck the foundation wall of the building. The other portion was torn from the steam drum and mud drum connection and projected against the opposite wall.

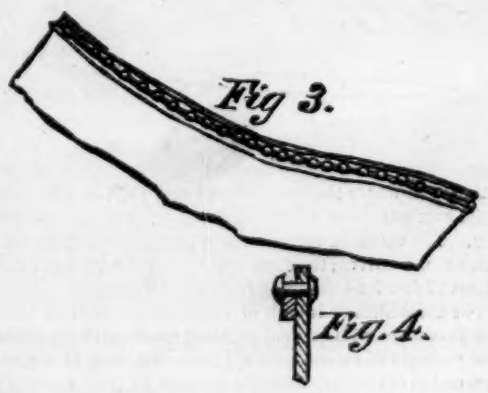


Fig 3.

Fig. 4.

In the writer's opinion, this explosion could not have been the result of low water, as the scale was present on the sheets and the flues retained their circular form; besides which, if this had been the cause, the other boiler would have shared the same fate, whereas it was uninjured, except that it was disconnected from its companion. On the other hand, there is abundant proof to my mind that the seams were weakened in the manner indicated.

In the sketch Fig. 1 represents the former position of the boiler, with the rear portion in the position in which it was left. Fig. 2 represents the front head with three sheets projected forward. Fig. 3 shows how the sheets were torn through the rivet holes. Fig. 4 is a section of the sheet to show more clearly the nature of the fractures. A. R. P.

Cost of the New York Aqueduct.

The proposed aqueduct which is to supply New York city with water is estimated to cost $15,664,308, according to the report of the Commissioner of Public Works. The estimate, the report says, is based on a rate of progress of 200 feet per month, that being understood to be the minimum rate intended to be required by the Commissioners. It is assumed that the tunnel for the aqueduct throughout its entire length will be in rock. The finished diameter of the aqueduct is taken to be 14 feet, and the diameter of the excavation 16 feet, with an allowance of one-third of a cubic yard in excess of that area for every foot in length, beyond which the contractor shall not be paid, unless otherwise provided for in the contract. This is equal to 7·75 cubic yards per lineal foot of tunnel. It is also assumed that the aqueduct shall be lined with an average thickness of three rings of brick, equal to 17·45 cubic yards per lineal foot, and that there will be a back filling of concrete of an average of three-tenths of a cubic yard per lineal foot.

The prices allowed are $9 per cubic yard for rock excavation; brick work, $13 per cubic yard; and back filling of concrete, $5 per cubic yard. The cost of the shafts is included in the $9 per cubic yard, as the cost is but a very small fraction of the total cost of the tunnel. The above prices make the cost $94.01 per lineal foot; to this should be added the cost of hoisting in shafts. This is estimated at $1 per 100 feet. The total length of the tunnel to the Harlem River is 129,098 feet. Of this length four-fifths will be worked by shafts and one-fifth by portal. Calling the total cost $96 per running foot, then 129,098 feet will give a total of $12,393,408. Of this length 34,800 feet is the siphon line and that part of the line under the Harlem River, and though of less diameter than the main conduit, it may be expected to cost about $4 per lineal foot in addition, or $139,200, making the total cost of the tunnel conduit from Croton Lake to the north side of Manhattan Valley $12,532,608.

In addition the above there are at Pocantico River crossing 2,300 feet; at Jay Gould's swamp crossing, 1,000 feet; at Saw Mill River crossing, 4,000 feet, and at Tibbitts Brook crossing 3,300 feet; making a total of 10,600 feet. Altogether there are 10,600 lineal feet of excavation, for which the data at hand is not sufficient to enable a better estimate than, say, $141 per lineal foot, or about 50 per cent in excess of the cost of the tunnel. The following is a recapitulation of the estimate:

Tunnel—Aqueduct from Croton Lake to north side Manhattan Valley	$12,532,608
Aqueduct in excavation	1,494,600
Gate houses and appurtenances at Croton Lake	150,000
Waste weirs	150,000
Pumping station, Harlem River	75,000
Gate house, north side Manhattan Valley	75,000
Piping from above gate house to Central Park Reservoir, including changes and connections with present mains and gate houses; pipes to have capacity of 100,000,000 gallons per day	1,187,100
Total	$15,664,308

Reduction of Metallic Solutions by Gases.

Dr. G. Gore, F.R.S., has recently concluded a series of experiments with various solutions of metals, in order to reduce them to the metallic state by contact with gases and different organic compounds. The solutions chiefly employed were those of palladium, iridium, platinum, gold, silver, and mercury; and less frequently those of copper, lead, iron, manganese, chromium, vanadium, and tellurium. The gases used were hydrogen, carbonic oxide, coal gas, and crude acetylene. The organic compounds included both liquid and solid substances. The liquids were amylene, petroleum, benzine, Persian naphtha, xylol, toluol, carbolic acid, "petroleum ether," mesitylene, and liquid chloride of carbon; while the solids were paraffin, ozokerit, naphthalene, anthracene, chrysene, elaterite, solid chloride of carbon, etc. By contact with gases, the metals were generally reduced in the form of films upon the surface of the liquids, as well as in that of precipitated powder; some of the films produced, both by the contact of gases and by that of non-miscible liquids, being remarkably beautiful, and of a surprising degree of thinness. Among the most conspicuous instances of reduction were the following: A solution of palladic chloride was rapidly reduced by carbonic oxide, hydrogen, coal gas, and amylene. One of terchloride of gold was quickly decomposed and reduced by coal gas, carbolic acid, and amylene. The most beautiful films were those which were produced by a solution of terchloride of gold with coal gas or with amylene. It is, Dr. Gore thinks, worthy of consideration by geologists whether the reduction of metals to the native state in the interior of the earth may not in some cases have been effected by contact of their solutions with liquid or gaseous hydrocarbons derived from coal and other mineral substances of organic origin.

HORSE-FLESH is, according to U. S. Consul Ballou, largely eaten in Alsace; the retailers sell the choice cuts for about 8 cents per pound; for ordinary, 6 cents. A large quantity is used in the manufacture of sausages. All horses are, before and after being killed, given a strict examination, and if found in any way diseased are rejected. The price of this meat renders it possible for many of the working-people to have meat occasionally upon their table, which would otherwise be impossible. The consumption of horse-flesh is principally confined to the working classes. The flesh of thirty horses is eaten every week in Strassburg.

False Comets.

The account of the remarkable phenomenon seen in Porto Rico, published in the SCIENTIFIC AMERICAN of the 19th of January, brings forth reports of several similar apparitions.

A correspondent, as well as a practical observer, gives a very interesting description of several of these shadowy ghosts of comets seen by him in Philadelphia and its vicinity. About two years ago, the writer, on his way from the city to his home, saw, in the southeast, a brilliant comet with a tail 2 degrees in length. On reaching home, he rushed to his observatory for a better view of his celestial visitor, but found no trace. It had disappeared as suddenly as it came.

A few evenings later, the comet was again visible, and the writer observed it through the telescope. There was no decided nucleus, and there was no perceptible motion, excepting a fluctuation of light. The next night, the phantom disappeared, and was seen no more.

About six months later, a fine comet was seen in the southwest by numerous observers, the writer being among the number. He examined it with the telescope, found its characteristics similar to those of the object seen in the southeast, and concluded that both objects were atmospheric phenomena, and were not in the remotest degree connected with the cometic family.

Our correspondent has kept close watch over the pseudo-comets for a year, and has elaborated an ingenious theory to account for their origin. He learned that from time to time certain gas wells had been "struck" within a radius of perhaps forty or fifty miles. He ascertained their bearings, and found that the positions of the shadowy comets corresponded with those of the gas wells.

This natural gas has recently been brought into this city. Escape pipes have been run up to the height of thirty feet or more, and when any break occurs, or other work is to be done, the gas is blown out through these escape pipes and then lighted. The result is that there are comets every time the gas is lighted if, at the same time, the atmosphere contains moisture in sufficient quantity to reflect the light from the jets, which extend upward for a great distance, rushing with great velocity on account of the immense pressure. The writer can see from his observatory three of these jets of burning gas, and a few evenings since, he saw three of the mythical comets. One of them seemed for a while to extend its tail from one of the stars in Ursa Major, and "was a comet that would deceive the very elect."

Our correspondent has received numerous letters concerning these deceptive apparitions, and incloses a telegram and letter as illustrations. The sender of the telegram is an experienced observer of McKeesport, Pa., and records the appearance of a "large, bright comet two hours preceding Aldebaran, due west," on the 6th of November, 1882. The writer of the letter is well posted on the subject, and describes the recent appearance of a "monster" comet in the southeast in the morning, as seen in the city by a domestic in his family.

We cannot be sure that the problem concerning the origin of false comets in Pennsylvania has been solved, any more than we can tell whether the recent superb afterglows have been caused by the Java earthquake or meteoric dust or some unknown agent. But the theory has a plausible aspect and is good till a better one is found.

The phenomena seen at Porto Rico and at Sulphur Springs, Ohio, are probably due to peculiar conditions of the atmosphere. They differ from the Pennsylvania phenomena only in being on a larger scale and more brilliant in manifestation. If there are no natural gas wells in these localities, there are other agents, within or without the bowels of the earth, capable of producing similar results. Doubtless, careful observers who study closely and ponder long may find some key to the mysterious pictures painted on the sky by the pencil of unknown artists.

Meantime, every wonder of the heavens is to be carefully noted, and recorded as an item in that vast collection of observations that constitutes the astronomical work of the present generation, and that will take form in the astronomy of the future. If observers are not fortunate enough to reach results, they will at least be helpers in a great structure built on a foundation partly laid in the present age.

Of one thing observers may be reasonably certain, that few real comets will escape sharp sighted astronomical eyes. A number of astronomers do little else but sweep the sky for comets. If one is found in telescopic search, no bigger than a pin head, it is eagerly seized as a rare celestial prize, and its advent is cabled all over the civilized world. Sometimes the comets manage to elude the astronomers. Thus, the great comet of 1882 appeared full fledged upon the scene, bright enough to be visible in the daylight, and in the near presence of the sun, when first discovered by northern observers.

A New Gas-purifying Material.

At the congress of the Societe Technique, held at Marseilles in May last, a communication was presented by M. Lux on the subject of the employment of alkalized hydrated oxide of iron for the purification of coal gas. The matter had previously been brought under the notice of the Italian Gas Managers' Society, at their congress held at Florence in the previous year, when M. Rebuffel, manager of the gas works at Milan, described and explained the use of the material. It is known by the name of *Luz-masse*, and its use is stated to be attended with very satisfactory results; the expenses of purification being reduced by about two-thirds when it is substituted for lime. Some trials of the material have been made at Leyden, the results being very carefully recorded. From these it appears that in the years 1881–82 the expenses of purification by the old system amounted to 2,300 florins (£192), while with the new process they did not exceed about 860 florins (£72). Very good results are said to be obtained by using a mixture of 1 part of the material with 5 parts of sawdust, and spreading it in a single layer about 2 ft. 3 in. thick. From an experiment recently made it was found that 1 cubic meter, or 27½ bushels, of the mixed material purified 123,000 cubic feet of gas without being changed. This is equivalent to something like 742,000 cubic feet for the above-named quantity of the material used in its pure state. The cost of the mixture at Milan is 15 frs. 76 c. per cubic meter, or, in round numbers, 6d. per bushel. The outlay for this system of purification, supposing the material to be used only once, would be 4 frs. 50 c. per 1,000 cubic meters, or, roughly, £5 per million cubic feet of gas purified; but, as it is susceptible of revivification as many as thirty times, the cost comes down to 15c. per 1,000 cubic meters, or about 3s. 6d. per million cubic feet of gas. Further economy may, however, be realized by carrying the process of revivification (which is effected in the purifiers themselves by means of a jet of air) still further; and even then it appears that the spent material would be salable.

A New Eucalyptus from Tonquin.

An extract from a paper on eucalyptus, which appeared originally in the Delhi *Gazette*, has been communicated to the Agri-Horticultural Society of Madras. It is as follows:

"Those who have introduced the eucalyptus in Ceylon as a fever plant will do well to gather some information about an entirely new and superior plant found indigenous in Tonquin. It is called the "y-dizi." It grows to a height of about six feet, and is not only a nutritious plant, but it destroys miasma and purifies stagnant water. Travelers, we are assured, use the y-dizi in the same manner as tea is used in China. The grains are stated to have valuable properties, affording a refreshing beverage, which purifies the blood, invigorates the stomach, and is diuretic. To make this beverage, the husk of the fruit is taken off the seeds, or, as they are called, almonds are extracted, and they are then boiled in water. Well-to-do people in Tonquin make very frequent use of the y-dizi during the summer. The plant grows well and rapidly, and produces a large quantity of seeds. It is sown near pools and streams, and around gardens in waste ground."

New Photo-engraving Processes.

The Klic process was a secret at first, but we are informed that the principle of working is as follows:

A copper plate is dusted with powdered asphalt, and the plate is heated so that the asphalt becomes nearly melted. A negative carbon print is now transferred on to the copper plate, and the plate, now covered with the negative in carbon, is etched, at first by a strong solution of perchloride of iron, which penetrates only the thinnest parts of the picture; then by a weaker solution of the same salt, the solution etching through the thicker parts. By employing more and more diluted solutions, it is possible to etch through thicker and thicker layers of gelatine, so that only the high-lights remain unetched.

One advantage of the Klic process is the circumstance that the plates are very quickly finished. Goupil, who takes an electrotype from a grained relief, requires several weeks for depositing metal of sufficient thickness. The etching process of Klic is rapid, and plates may be produced in a day or less.

Obernetter's Photo-Engraving Process.—The eminent photographic chemist Obernetter, of Munich, to whom we are indebted for so many improvements in photographic matters, has invented a quite new process, which gives results like Goupil photogravure. He has sent excellent proof-pictures by his process to the Society for the Advancement of Photography in Berlin.

The most striking feature of the Obernetter prints is the richness of the tone in the lights, and the principle of the method is stated to be as follows: A diapositive is made by the Obernetter method on a plate containing a maximum of silver and a minimum of gelatine, and the film, having been stripped, is treated with a mixture of perchloride of iron and chromic acid, so as to convert the whole of the silver into chloride. This film, charged with chloride of silver, is now placed in contact with a copper plate, and the copper gradually decomposes the silver chloride, metallic silver being liberated. This decomposition of the chloride is of course accompanied by a corresponding etching of the plate.

The new principle now published is an important one, and we have found that if a collodion positive or an ordinary gelatino-bromide transparency is converted into a chloride picture by suitable means, it easily etches a copper plate with which it is pressed in contact. We found the method described by Mr. E. De Zuccato in these columns to be the most convenient for converting the silver picture into chloride, viz., treating with a mixture of dilute hydrochloric acid and bichromate of potassium.

If the film, before being placed on the copper, be moistened with a weak solution of chloride of zinc, the etching proceeds more rapidly than otherwise.

We are not aware that the new method of etching copper plates has been patented in this country, and we hope our readers will try a few experiments with the process and let us know the result. It is scarcely necessary to say that the method is also adapted for the production of high or typographic plates, but in this case the lines of the chloride of silver picture must correspond to those parts of the block which are required to print white.—*Photo. News.*

Obituary.

PROFESSOR C. A. SMITH.

The death is announced on Feb. 2 of Prof. Charles A. Smith, from 1869 till a little more than a year ago Professor of Civil Engineering in Washington University, St. Louis, but at the same time engaged in the practice of engineering to an extent rare among instructors.

Professor Smith was born in St. Louis April 8, 1846, but in his infancy his parents removed to Newburyport, Mass., which he seems to have considered his home thereafter, and whither he returned to die. He was educated at the Massachusetts Institute of Technology, Boston, where he graduated in 1868 in a class including the late Frank R. Firth (who rose to be Superintendent of the Atchison & Nebraska Railroad, and was killed by an accident on it only four years after graduating), and Prof. Charles E. Greene, of the University of Michigan. After graduating he was for a time in the office of Mr. J. B. Francis, of Lowell, the eminent hydraulic engineer, and with Professor Henck, of Boston. He was engaged for a time in the surveys for the Union Pacific Railroad, and also made some surveys in North Carolina. But it was very soon after graduating that he began to give instruction in engineering in Washington University, and nearly all his practical experience in engineering was gained while he was professor there, his duties having been purposely arranged so as to enable him to spend a large part of his time in engineering work, which, perhaps because of his position as a teacher, he pursued with a student's eagerness. At one time he made a special study of bridge work, and was intimately associated with the accomplished engineers who built the St. Louis Bridge; he also made plans for water works at Hannibal and St. Charles, Mo., and for pumping machinery at Richmond, Va. A little later he turned his attention to mechanical engineering; and thenceforward seems to have made that his chief study. With Mr. Jacob Johann, of the Wabash Railway, he made some experiments with locomotives, the results of which were published with the reports of the Master Mechanics' Association, and recently he has been writing "A Practical Treatise on Boilers and their Use," which is appearing in the *American Engineer*, and will be published in book form by Wiley.

Professor Smith was a man of great energy and enthusiasm in his profession, eager to experiment and investigate, and had already made such additions to engineering knowledge that much was to be expected from him in the future. Aside from his books, which have not yet appeared, he was the author of various reports and many short articles in technical journals, the first of which, probably, appeared in the *Railroad Gazette* more than 12 years ago. For 12 years he was Secretary of the Engineers' Club of St. Louis. He was an associate member of the Master Mechanics' Association, and made important contributions to its papers. He was a member of the American Society of Civil Engineers from April, 1880.

JOHN HUTTON BALFOUR, F.R.S.

This distinguished scientist, Professor of Botany in the University of Edinburgh, and author of several books on that subject, died in February, in the seventy-sixth year of his age. He was a graduate of the Edinburgh College of Surgeons, and practiced medicine in that city some years until elected to the chair of botany, in 1845.

S. WELLS WILLIAMS, LL.D.

Professor Williams, Lecturer on Chinese at Yale College, died in New Haven, Feb. 16, in the seventy-second year of his age. In 1833 he went to Canton as printer to the American Board of Foreign Missions, where he rapidly gained an extensive acquaintance with the Chinese language, and published a number of standard books. Professor Williams completed at Macao, in 1835, the printing of Medhurst's "Hokkeen Dictionary." In 1837 he visited Japan to return some shipwrecked sailors, and soon after learned the Japanese language, into which he translated the Book of Genesis and Matthew. He aided Dr. Bridgman in preparing the "Chinese Chrestomathy," and in 1842 he published his "Easy Lessons in Chinese." This was followed in 1844 by "The Chinese Commercial Guide" and an "English and Chinese Vocabulary in the Court Dialect." In 1845 Dr. Williams returned to the United States, and in 1848 he published "The Middle Kingdom," a work still considered to be the best of the kind on China. In 1848 he returned to China with a new font of Chinese type, made in Berlin. In 1853–54 he accompanied Commodore Perry to Japan as the interpreter for the expedition. He was appointed secretary and interpreter for the United States Legation in Japan, of which he had charge until the arrival of the first Minister. In 1856 Dr. Williams published a "Tonic Dictionary of the Chinese Language in the Canton Dialect," but most of the copies were burned with the mission press at Macao, in December of that year. In 1858 he aided William B. Reed in negotiating the treaty of Tientsin. In 1874 he brought out at Shanghai the great work of his life, "The Syllabic Dictionary of the Chinese Language," and in 1876 he returned to the United States, having been appointed Lecturer on Chinese at Yale College, where he remained until his death.

ENGINEERING INVENTIONS.

An improved car brake has been patented by Mr. Charles Treagoning, of Lead City, Dakota Ter. This brake is applied automatically to cars by the slackening of the speed of the engine, and is removed when the engine exerts sufficient pressure to back the cars, a special construction providing that, as the drawheads meet, they will apply the brakes to different cars in succession.

An air or liquid brake has been patented by Mr. Robert M. McKinney, of Elizabeth, Penn. The invention covers contrivances whereby air or liquid pressure is made to hold springs in tension, to be released to apply brakes to car wheels, and so under the engineer's control that the brakes may be put on all the cars of a train simultaneously, or only on one or another as desired.

An improved car coupling has been patented by Mr. John J. Lloyd, of Streator, Ill. A sliding block is arranged for in the link socket, with a spiral spring behind, and bearing against a bolt, crossing the socket and supporting the spring, so that whenever the coupling pin is raised the block is thrust forward to hold it up, or when the cars come together it will be tripped and let fall.

A car truck has been patented by Mr. Alexander E. McConnell, of New Orleans, La. The invention covers novel combinations and arrangements of a series of superimposed wheels and their axles and bearings with a series of car axles in the same truck or frame, to reduce friction and wear of the bearings, save lubricators and the heating of axle boxes besides, the wheels being made to run steadier.

MECHANICAL INVENTIONS.

A pipe wrench has been patented by Mr. Daniel S. Brown, of Burdette, N. Y. This is a wrench wherein, by gearing the handle and jaw together by sectors, the jaw will be brought to the desired position, so the wrench may be easily applied to a pipe or other object to be turned, and the jaw may be closed and held thereon with great firmness.

A spoke shave has been patented by Mr. Addison E. Chapman, of Olean, N. Y. The handle has a recess to receive a blade, a wedge of special design, and a screw peculiarly shaped and located, the whole forming a fastening device to firmly hold the blade in place, yet one that may be quickly loosened to release the blade.

A cutter head for handle turning lathes has been patented by Mr. John D. Westcott, of Union City, Pa. Its special feature is that the edges of the knives are separated by the centrifugal force and are brought together by the action of beveled arms on beveled blocks or lugs; the turned stick passes through a tubular shaft, and the knives can be set to give the stick any desired maximum diameter.

A globe valve grinder has been patented by Mr. John E. Doyle, of Richmond, Ind. The tool covers a cylindrical socket armed with sharp steel points at its lower extremity, together with a bushing, and is adapted to grinding valves of various dimensions, especially worn out ones, without removing the valve, shell, and seat from the pipe, the construction being such that the valve may be firmly grasped and rotated without injury to the valve stem.

AGRICULTURAL INVENTIONS.

A sulky cultivator has been patented by Mr. Reading L. Carver, of Pre-emption, Ill. This invention covers a special combination and arrangement of parts whereby the plow beams can be adjusted at a greater or less distance apart as may be desired, and the general effectiveness and reliability of cultivators increased, as well as convenience in guiding and controlling them.

A sheep shearing table has been patented by Mr. Joseph L. Addison, of Quaker City, Ohio. The invention covers a bench with revolving seat, for seating the sheep on his haunches, and above the seat is a shoulder, neck, and head rest, with straps for securing the sheep, so the shearer may employ both hands, and readily turn the seat as desired, the fleece falling on the bench.

MISCELLANEOUS INVENTIONS.

Fireproof timber forms the subject of a patent issued to Mr. William H. Dolman, of New York city. The object is to form convenient pockets or chambers for holding non-conducting material around building and other timbers, for which purpose narrow strips and metallic sheets are combined with the joists, rafters, etc., according to a specially provided plan.

A combined implement for tailor's use, covering a chalk knife, waste chalk receiver, pin cup, and paper weight, has been patented by Mr. Claudius Edlund, of Brooklyn, N. Y. There is a hollow body with top and bottom openings and recessed top, with jaws recessed to receive knives with corrugated faces, the bottom opening being closed by a stopper.

An improved process for relining dental plates has been patented by Mr. Frank T. Hyatt, of Norwalk, Conn. The process covers the cutting out of the old plate, so that only the gums holding the teeth remain, then forming a thin lining of rubber on the top of the gums, and by means of this lining uniting the gums and forming a new roof plate.

A show box for trimmings has been patented by Messrs. S. G. Bernstein and Michael Simonson, of New York city. This invention covers several combinations of parts to prevent trimmings from becoming shop worn, so the goods may thereby be nicely kept in hanging position without being crushed, folded, or wrinkled, and may be easily handled and exhibited.

A corn silking machine has been patented by Mr. William S. Horn, of Mill Green, Md. It is for removing the silk of green corn preparatory for canning, and covers a traveling belt provided with points or fingers, a brush for cleaning the fingers, a hopper, and a feeder, with special practical devices to promote its rapid operation and thoroughness of work.

A spike extractor has been patented by Mr. John Ebbert, of Rockaway Beach, N. Y. This invention relates to certain improvements on a former patent to the same inventor, whereby the drawing of railway spikes may be more conveniently effected when the rails are of different heights, and the tool may be made stronger, cheaper, and more durable.

A packer for flour, bran, etc., has been patented by Messrs. Jacob and Benjamin C. Frysinger, of Rock Island, Ill. This invention covers a novel construction in pressers for packing flour, etc., in cases or barrels, the press box having a chute and slide in one side, and in another side an opening with a sliding apron for placing a head between the compressing follower and the material to be compressed.

A process of and apparatus for extracting crystallized sugar from bagasse has been patented by Mr. Thomas B. Yale, of Columbia, Texas. The bagasse is subjected to hot steam while it is under heavy pressure in a suitably devised cylinder, then the steam is shut off and an air pump put in operation to withdraw the juice and dissolved crystallized sugar from the saccharine material by means of a vacuum.

A wagon tongue support has been patented by Mr. Nathaniel Johnson, of Harrisburg, Ill. Combined with the axle is a plate held on the ends of a yoke secured to the axle, to which plate and the axle the hounds are fastened, between which the rear end of the tongue is held, the design being to relieve horses of the weight of the tongue, and also allowing the tongue to be readily detached from the wagon.

A ball rack for pool playing has been patented by Mr. Jacob S. Hausman, of New York city. The rack has a back plate with vertical rack bars, and with plates hinged to the lower edge, the hinged plates being connected by pivoted bars and levers, and to the lower hinged plate are dovetailed flanges to hold a triangular plate, short spouts serving to guide the balls from the side parts of the track to the triangle.

A beer cooler has been patented by Mr. Charles A. Bartliff, of Bartlett, Tenn. It is a transformable beer and water cooler and mixer of stale and fresh beer, whereby flat beer may be revived, and for this purpose a combined ice basket and beer pipe are so arranged that, even with a constant stream of beer through this cooler and mixer, the gas of the fresh beer will have time to act on and revive the stale beer.

A combination lock has been patented by Mr. Charles Tregoning, of Lead City, Dakota Ter. This lock has concealed notched disks connected with a visible index, means for changing the relation of the disks to their indices, for drawing the bolt or for preventing it from being drawn, thus providing a lock to be operated without a key and adapted in form and size for trunks, doors, safes, etc., and one that can be changed to operate under different indices.

An improved velocipede has been patented by Mr. John W. Woodruff, of Wise, West Va. The foot power is applied to the driving wheels by ratchet and pawl mechanisms by oscillating a horizontal tread wheel with the feet, the tread wheel being in front of the driver's seat, and so connected by ratchet hubs on the axle that the ratchet of one hub drives ahead while the other reverses, and there is a hand lever contrivance for combining foot and hand power.

A ball trap has been patented by Mr. Chas. F. Stock, of Peoria, Ill. This is a positively-acting device for throwing into the air clay pigeons, glass balls, and other objects for target practice. A hollow post supports the operative parts, there are two interchangeable throwing arms, so supported that they may give the target any desired direction, and it is provided that an operating cord leading twenty or more yards away may be used by the sportsman to work the trap.

A bicycle has been patented by Messrs. Richard C. Thompson, of Brixton, and William Spence, of Surbiton, Surrey County, England. In combination with the steering fork are arms attached rigidly to the lower extremities of the fork or formed therewith, and passing clear of the paths of the cranks and pedals, and rising at either side of the steering fork at such distance therefrom as to admit the rider's legs between them and the fork, and of handles attached to the upper ends of the arms.

An improved form for hulls of vessels, admitting of a construction designed to give high speed with great economy of power, and be also practically unsinkable, has been patented by Mr. Amedee M. G. Sebillot, of Paris, France. The vessel has three longitudinal compartments, the middle one narrow and sharp at both ends, the outer ones increasing in width to about the middle of the vessel, and then extending to the stern at a uniform width, where they are rounded. The side compartments are flat-bottomed, and do not extend down as far the bottom of the middle compartment.

NEW BOOKS AND PUBLICATIONS.

THE TOPOGRAPHER; HIS INSTRUMENTS AND METHODS. By Lewis M. Haupt, A.M., C.E. J. M. Stoddart, New York, Philadelphia, and London. Illustrated.

The importance of that department of engineering occupied by the topographer, and the absence of any publication laying special stress upon the duties, requirements, and theoretical qualifications necessary for the position, led to the writing of this book. After defining the requisite characteristics of the topographer, the author describes the latest improvements in instruments with their numerous time and labor saving devices. It is impossible in so brief a notice to give more than a list of the subjects treated, among which are scales of maps, forms of record, graphical representations, reconnaissance, instruments and methods, determining a true meridian, leveling, surveying, and filling in, hydrography, underground topography, field sketching, computations, and modeling. The final chapter deals with the applications. Prof. Haupt has produced a manual of great practical value to the embryo topographer, and one which the experienced engineer will find to be of much use.

ILLUSTRATIONS OF A VARIETY OF FLIES.

A beautiful and most artistic representation of trout and black bass flies has been published by M. Wakeman Holberton, of 50 Maiden Lane, New York. There are two plates, one for each variety, on a sheet 18 x 26 in., suitable for framing, and effectively colored by hand by Mr. Holberton himself. In the center of each plate a fine specimen of one or the other of these gamy fish is graphically portrayed.

COOKERY FOR BEGINNERS; FAMILIAR LESSONS FOR YOUNG HOUSEKEEPERS. By Marion Harland. D. Lothrop & Co., Boston. 16mo. Price $1.

This book is truly entitled one "for beginners," as it tells at the outset how to make the yeast and the first loaf; the book does not neglect in the latter chapters to tell about making desserts, cake, jellies, cream, etc., but these have only their proper proportionate place, and the solids of plain cookery get not only the first place, but thorough, honest, and straightforward treatment.

TABLES FOR CALCULATING THE CUBIC CONTENTS OF EXCAVATIONS AND EMBANKMENTS BY AN IMPROVED METHOD OF DIAGONALS AND SIDE TRIANGLES. By John R. Hudson, C.E. John Wiley & Sons, New York. Price 75 cents.

This will no doubt prove a handy book to railroad engineers especially. While embankment and excavation tables are in existence, the author of the present tables claims a superiority over them as regards both accuracy and rapidity of calculation. The method employed divides the work into level cross sections and side triangles. The tables give the contents in cubic yards for heights ranging from 0 to 50 feet, advancing by one-tenth of a foot and with roadbeds varying in width from 10 to 28 feet, together with varying side slopes. The book gives the method of calculation, and several examples make the use of the tables clear.

PLANT DESCRIPTION, OR RECORD BOOK FOR PLANT ANALYSES. By George G. Groff, A.M., M. D. Science and Health Publishing Co., Lewisburg, Pa.

RAILWAY TURN OUTS. A system of laying out instantly by inspection from tables. By Jacob M. Clark. D. Van Nostrand, New York.

ELECTRICITY AND MAGNETISM. Notes designed to accompany Silvanus P. Thompson's Elementary Lessons. By Lieut. J. B. Murdock, U. S. Navy. Macmillan & Co., New York.

An illustrated catalogue and price list of fine fishing tackle has been published by Messrs. Abbey & Imbrie, of 48 Maiden Lane, New York. The book has 91 large plates, covering almost every conceivable appliance in this line, and in such profusion of styles as would probably delight even our most expert of fishermen, President Arthur.

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Hoisting Engines for Mines, Quarries, Bridge Builders, Railroad Construction, etc. Send for catalogue. Copeland & Bacon, New York.

Quinn's device for stopping leaks in boiler tubes. Address S. M. Co., South Newmarket, N. H.

"How to Keep Boilers Clean." Book sent *free* by James F. Hotchkiss, 86 John St. New York.

Iron Planer, Lathe, Drill, and other machine tools of modern design. New Haven Mfg. Co., New Haven, Conn.

Pumps—Hand & Power, Boiler Pumps. The Goulds Mfg. Co., Seneca Falls, N. Y., & 15 Park Place, New York.

Fox's Corrugated Boiler Furnace, illus. p. 354. Hartmann, Le Doux & Maecker, sole agents, 134 Pearl St., N.Y.

Wairus Leather. Emery, Nickel Anodes, Nickel Salts, and Polishers' Supplies. Greene, Tweed & Co., New York.

Gears.—Grant, 4 Alden St., Boston.—Water motors.

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If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN Patent Agency, 261 Broadway, New York.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

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Railway and Machine Shop Equipment. Send for Monthly Machinery List to the George Place Machinery Company, 121 Chambers and 103 Reade Streets, New York.

Wanted.—Patented articles or machinery to make and introduce. Gaynor & Fitzgerald, New Haven, Conn.

Water purified for all purposes, from household supplies to those of largest cities, by the improved filters manufactured by the Newark Filtering Co., 177 Commerce St., Newark, N. J.

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Lightning Screw Plates, Labor-saving. Tools, p. 92.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 108.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 110.

Steam Pumps. See adv. Smith, Valle & Co., p. 107.

Catalogues free.—Scientific Books, 100 pages; Electrical Books, 14 pages. E. & F. N. Spon, 35 Murray St., N. Y.

Drop Forgings. Billings & Spencer Co. See adv., p. 125.

Ajax Metal Company, Phila. Clamer's Ajax Metals for railroad, rolling mill, engine bearings, cocks, and valves.

Curtis Pressure Regulator and Steam Trap. See p. 142.

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Best Popular Science Works, 15 cents. J. Fitzgerald publisher, 20 Lafayette Place, N. Y. Catalogue free.

Gould & Eberhardt's Machinists' Tools. See adv., p. 141.

Barrel, Keg, Hogshead, Stave Mach'y. See adv. p. 142.

Combined Concentric and Eccentric Universal and Independent Jaw Chucks. The Pratt & Whitney Co., Hartford, Conn.

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Woodwork'g Mach'y. Rollstone Mach. Co. Adv., p. 141.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 142.

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Notes & Queries

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No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at the office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their indentification.

(1) H. S. H. asks: If a bichromatic battery could be used for silver plating small articles, and also for making small electrotypes. If so, how large a one would be needed for plating pins, chains, etc.? If a bichromatic battery would not answer, what would be the best kind and size for above work? A. Better use a Daniels or gravity battery. Two or three cells will do.

(2) C. E. S. writes: I have made an induction coil giving a spark of six-eighths in. with one cell of Grenet battery, size of plates 6 x 8 in. This coil will give a spark of only one-eighth in. with one cell of gravity battery. What I wish to know is how many cells of gravity battery I must connect for quantity to give a spark of six-eighths in. with the aforesaid coil? A. It will require eight or ten cells of gravity battery to produce the results secured by your Grenet battery.

(3) G. W. E. asks: How the celebrated "amber varnish" is prepared, such as is seen on genuine Cremona violins? A. It is impossible to give you the ingredients of the varnishes used in the manufacture of violins by makers such as you mention. Their method of treating the violin was kept a secret. The following we can recommend as being desirable. Rectified spirits of wine, half gallon; add 6 oz. gum sandarac, 3 oz. gum mastic, and half pint turpentine varnish. Put the above in a tin can by the stove, frequently shaking until well dissolved; strain, and keep for use. If you find it harder than you wish, thin with more turpentine varnish.

(4) J. W. H. asks: 1. Is a five foot wheel with three inch pitch, nine inch face, sufficient to carry the power from an engine, bore eighteen inches diameter, piston velocity 400 feet per minute, steam pressure 75 pounds on boiler? A. If of very strong iron your wheels would answer, but we should not consider them safe for over 90 horse power. We think they should be at least 3¼ inch pitch and 10 inch face, and diameter 5½ feet. 2. Will the engine give 150 horse power? A. Allowing 60 pounds average pressure on piston, the power will be 150 horse power; if the average pressure is less than 50 pounds, the speed must be increased to be 150 horse power. 3. Will webbing the wheel deaden the noise much? A. It would do so to some extent.

(5) M. J. B. asks: Will the electrical machine described in SUPPLEMENT No. 161, and 4 of the No. 4 batteries described in SUPPLEMENT No. 149, connected with the light machine in SUPPLEMENT No. 149, give light equal to a common kerosene lamp? A. Better use the machine and batteries on an incandescent lamp. It is difficult to make a small arc lamp work well for any length of time.

(6) A. L. D. writes: Please inform me what the ascensional force of a cubic yard of hydrogen is? Which has the greatest ascensional force: hydrogen, coal gas, or hot air? How can I manufacture hydrogen? What would apparatus for making hydrogen cost that would make 50 to 60 cubic yards per hour? A. It requires about 13 cubic feet of hydrogen to support one pound in the air. Hydrogen is lighter than coal gas, but the latter is now generally used in balloons. Hot air is no longer used except in toy balloons. Hydrogen is made by pouring dilute sulphuric acid on iron filings or turnings. You will find instructions for making it in almost any work on chemistry. The apparatus is not expensive; a few well made barrels is about all that is required.

(7) C. K. asks: Will a kerosene oil heating stove radiate more heat with a heating drum on than without? If there is a certain amount of heat in a gallon of oil, how can it be augmented by a drum? A. When the heat of the flame is communicated to the drum, the radiating surface is increased and the same amount of fuel is rendered more effective owing to the superiority of the iron over air as a conductor and radiator of heat.

(8) J. B. says: Can you give in your Notes and Queries any practical plan of drying the cellar of a city house quickly after it has been flooded. As the ceiling of the majority of cellars is below the surface of the ground, there is no way to create a draught. A. Keep up a good fire in the cellar furnace, and (1) open the door from basement hall to cellar; or (2) make an opening from outdoors for the entrance of fresh air near the bottom of cellar, and extend the draught opening of furnace, by means of a box, nearly up to the ceiling. A few words on the spot in cases like this, by some one accustomed to dealing with ventilating problems may save other visits by the family doctor.

(9) W. C. W. asks: Is there any non-conductor of magnetism, or, in other words, is there anything that when placed between a magnet and piece of iron will prevent the iron from being attracted by the magnet? A. No insulator for magnetism is known.

(10) W. L. & Co. write: We have a set of well boring tools here; would like to know the strength of gas pipe (the ordinary pipe used for gas and water purposes) compared with square or round iron rods. We use 1¼ sq. rods, but they are not strong enough for the boring here. If it can be ascertained, would like the strength of 2 in. pipe compared with 1¼ sq. iron on test of its resistance to twist? A. The torsional strength of your square rod is not as great as a round rod of the same weight per running foot. The torsional strength of a square rod is not as great as a tube containing the same area of metal by 25 per cent. The weight of 1¼ in. square iron is about 4¼ lb. to 1 foot in length; 25 per cent off leaves 3,¹⁹⁄₂₀ lb. per foot for a wrought iron pipe of equal strength. The nearest to this figure is 1¼ in. extra strong pipe. Two in. common pipe weighs 3½ lb. to 1 foot and is stronger than your 1¼ in. rod, but common pipe as now made is thin at the threads and liable to accidents for drilling purposes, unless extra precaution is taken to make a strong joint. Sometimes the threads are cut large, so as to *vanish* the taper, with the couplings to match. This makes a strong rod for the diamond drill, and is in use in this part of the United States. We would recommend to you, if you have much drilling to do, to use the extra strong pipe 2 in. as being no heavier than your 1¼ in. square rods, and with much more torsional strength, its extra thickness allowing of your making stronger couplings than can be made with common pipe.

(11) E. H. D. asks: What the composition is that is used on the backs of mirrors; I mean the black, not the silver, also how to apply it? A. Use a black coloring matter dissolved in a japan varnish. It can be applied with a brush. Frequently an orange or red coloring material is employed.

(12) L. A. B. writes: 1. I have about 5,000 gallons of red claret that has become sour. Is there any way of restoring it to its former state—how? How can I make good white vinegar out of it? A. Sour wine may sometimes be restored by the addition of neutral tartrate of potassium or potash alone. Thus to 25 gallons of wine add 4 ounces potash dissolved in a little water and stir well with a stick for ten minutes. The manufacture of vinegar is given on page 3936 of SCIENTIFIC AMERICAN SUPPLEMENT, No. 247; to make it *white* filter it through bone black. 2. How can I store minute quantities of electricity? A. Minute quantities of electricity are not of much account in any system of storage at present known. You can do it by making a storage battery, according to directions given in the SCIENTIFIC AMERICAN and SUPPLEMENT.

(13) W. P. C. asks: Is there any objection to using condensed water from heating coils and radiators over and over again in our boilers? We have a case when we use nothing but rain water in the boilers. Have a large number of radiators, and return all condensation to the boilers continually. Some say it will injure the boilers; would like to hear from you. A. We do not think any injury can take place, but would advise that the condensed water be discharged into a tank, so as to be exposed to the air before returning to the boiler.

(14) A. B. writes: I wish to know through your valuable paper if a skillful engineer, controlling and handling an Edson recording and alarm steam gauge, cannot settle or fix the machine according to his own wants, and thereby prevent his employer from having an exact return of the variations of the steam used? If he could do it, by what means can he reach his object? A. When the gauge referred to is properly fitted and locked, it could not be readily tampered with. Of course the pipe leading from the boiler to the gauge might be cut, and the "skillful engineer" might insert a device to maintain any desired pressure; but as is common in such cases the "skillful engineer" might become the victim of his own designs.

(15) F. W. M. asks: 1. Whether the twisting strain is less in a rod 10 ft. long than in one 4 ft. long of the same diameter? A. The ultimate torsional strength of the long rod is as great as the short one. But the long rod has a greater range of torsion, and should be somewhat larger than the short one for stiffness. 2. Also the smallest size of shaft that would resist the power of one horse turning it at 15 ft. distance length of lever? 2. The size of shaft for one horse on a 15 ft. lever should be 2 in. diameter, and 2¼ in. if the nature of the work is liable to sudden stoppage, so as to largely increase the strain.

(16) H. C. W.—Glass beads are made by drawing the glass into small tubes and breaking the tubes into suitable lengths for forming the beads. The material is then placed upon a flat plate like a frying pan, which is heated just hot enough to allow the glass to draw the sharp edges into a round; at the same time the plate or pan is gently vibrated so as to prevent cohesion of the softened beads. A cylinder is also used something like a coffee roaster on a small scale. The cylinder can be made of cast iron quite thin. Faceted beads are made by pressing the glass in small moulds that have sharp edges and a punch, so that the eye is punched and the bead faceted at one operation, using small rods of glass heated in a muffle furnace. The manufacture is mostly confined to Birmingham, in England, and Venice.

(17) G. A. T. asks for a receipt for a cheap blue paint which dries quickly and is suitable for heads of barrels? A. Prepare a paint by mixing ultramarine or a cheap Prussian blue with resin dissolved in benzine.

(18) G. B. S. asks: 1. How can I stain maple wood to make it look like rosewood? A. To produce a rosewood stain take equal parts of logwood and redwood chips, boil well in water sufficient to make a strong stain; apply it to the furniture while hot; two or three coats, according to the depth of color desired. 2. What will keep a new cast iron tea kettle from rusting? A. In time the iron will become coated with calcium carbonate, which it will absorb from the water, and thus work out its own cure. There are enamels, but it would be necessary to fuse these on to the iron, which is probably not practicable in your case.

(19) F. J. H. asks: How to color cotton Turkey red? A. First oil the cotton with Turkey red assistance, and then allow to age for a day or so. Next steam the material and then mordant it with hot sumac for twelve hours, and again with aluminum acetate; rinse out, steam, and dye boiling with alizarine red. After dyeing rinse or clean with boiling soap or soda.

(20) W. H. P. asks: What solution or acid shall I use for taking the black from small steel goods, so that the surface will be left in good condition for taking a fine polish? In what way can small steel goods be polished so that they will also take a fine blue? A. If the goods cannot be tumbled or brushed with pumice stone or tripoli, or if the *black* is too deep, brush with fine emery. If it is necessary to dip the goods, a bath of hydrochloric (muriatic) acid and water—one part acid, eight to ten parts water—and rinse in hot soda and water and then in clean boiling water and dry quickly. Small steel goods can be tumbled with fine sand to receive a grained surface. If not suitable for tumbling, brushing or buffing is next in order, which can be done the same way that jewelry is polished, only that the finest flour of emery should be used, as bluing goods do not require a high polish.

(21) T. L. asks how to make ordinary solder, such as is used for tin work, stick to cast and wrought iron, also the best way to tin a solder iron? A. To muriatic acid in a glass jar give as much of zinc chips or filings as the acid will take up. File or otherwise brighten the cast or wrought iron, apply the acid with powdered resin and the hot soldering iron with common solder or pure tin. Tin a soldering iron (or copper) by heating it, rubbing it on a brick to brighten it, and applying the acid and resin as before, with solder.

(22) C. S.—In order to produce a glass enamel for metals, 125 parts of ordinary flint glass, 20 parts of soda, and 12 parts of boric acid are melted together. The coloring matter should be added to above mixture. In the case of white enamel add tin oxide or cryolite. The fused mass is thoroughly incorporated and poured out on metal or stone, and when cold powdered. The powder is mixed with water glass of 50° B.; the metal which is to be enameled is then covered with the mixture. The object prepared in the above described manner is then heated to the points at which the glass melts in a muffle. This enamel will be found very tenacious if applied to iron and steel.

(23) G. W. C. asks: Can lead, copper, or brass be nickel plated? A. Yes. See SUPPLEMENT, No. 310.

(24) G. W. asks for a receipt for oxidizing silver various colors. A. There are two distinct shades in use, one produced by a chloride, which has a brownish tint, and the other by sulphur, which has a bluish black tint. To produce the former, it is only necessary to wash the article with a solution of sal ammoniac (ammonium chloride). A much more beautiful tint may be obtained by employing a solution composed of equal parts of copper sulphate and ammonium chloride in vinegar (or dilute acetic acid). The fine black tint may be produced by a slightly warm solution of sodium or potassium sulphide.

(25) F. O. asks: 1. Can zinc be prepared so as to avoid oxidizing on exposure for a long time to the atmosphere, and still retain the color and characteristics of zinc? A. No. 2. Can it be entirely freed from copper? If not, what effect will the usual amount of copper in zinc have, so far as rusting is concerned, and can zinc be successfully used in manufacture of tombstones? A. It can be freed from copper by distillation; the copper hastens the oxidation. We see no reason why zinc could not be used for tombstones except for the oxidation. 3. What are white bronze monuments, and will they resist the action of the elements for any length of time? A. White bronze is composed of varying proportions of copper, zinc, and tin, with 20 per cent of nickel. This latter ingredient gives the desired tint and renders the alloy almost entirely inoxidizable. See SCIENTIFIC AMERICAN for June 3, 1882.

(26) G. W. H. asks: What colors are used in coloring geographies, maps, etc.? Please give us the trade name for yellow, pink, and blue. A. The colors used: brown called sepia; yellow called gamboge; pink called carmine; and blue called soluble blue. These are all dry colors that can be dissolved in water.

(27) W. G. J. asks: 1. What is the composition of "fixitif," used in "fixing" pencil and crayon work (keep from rubbing off)? A. A thin solution of shellac reduced with alcohol. 2. What causes the harsh, ringing, jarring vibrations of guitar strings at times? A. The shrinking of the gut within the wire.

(28) A. T. M. writes: I would like to know if there is any inexpensive way by which I could produce an electric light large enough to light a room 12 x 12 by a high speed model engine, the cylinder about ¾ x 2 inches? A. Your engine is too small. Better use a battery.

(29) G. S. writes: I have been experimenting a long time, and cannot come to a conclusion whether a magnet must be employed in a galvanic battery or not, in order that it may be felt. In most all such, especially medical batteries, I perceive a magnet and a vibrator which, in turn, is attracted and repelled from the magnet. I venture to ask if you could not give me a simple method of arranging a battery in such a manner that it may be felt? A. You can arrange an electro-magnet in your battery circuit, and place the armature on a flat spring which will allow it to vibrate in front of the holes of the magnet. Take a wire from your battery to the armature spring. Arrange another wire to touch the back of the spring, and connect with one terminal of the magnet. Connect the other terminal of the magnet with the battery. Now connect with each terminal of the magnet a wire provided with a metal handle, and the arrangement is complete. The armature will be attracted toward the magnet until the contact of the armature spring and wire is broken; the armature will then be released, when the spring will make another contact, and so on. The extra current generated in the coil of the magnet, will be felt by the hands applied to the handles. Medical machines generally employ an induction coil.

(30) E. R. writes: I have an induction coil capable of giving a 3½ in. spark with 3 quart size Bunsen cells. Is such a machine capable of giving a fatal, or even a dangerous shock? A. The shock would be painful and injurious, but probably not fatal to a person in health. It is best to avoid strong electric shocks in any case.

(31) O. M. W. writes: I have made a small slide valve engine, size 1½ x 3 in. Now, I wish to make a small copper boiler to run it, but do not understand the construction of one. Will you please let me know the name of a book which contains directions for making small steam boilers? Have you a SCIENTIFIC AMERICAN SUPPLEMENT that would answer? A. We know of no work on small steam boilers. Make the shell of your boiler 12 in. in diameter and 24 in. long from metal three thirty-seconds in. thick. Make the heads five thirty-seconds in. thick, double rivet the seams, and put in 36 to 40 1 inch copper tubes expanded at the ends. 2. Will I be able to cast brass in the moulds spoken of in SCIENTIFIC AMERICAN SUPPLEMENT, No. 17, or will I have to use sand moulds? A. Use sand moulds for brass casting.

(32) J. W. writes: Which is the correct side of a leather belt to run next to pulley? I had an argument about belting, and I said that a belt run with the flesh side to the pulley would last longer and eventually be just as good and smooth as if it were run the other way. My friend says it won't. A. Either side. But many mechanics and millwrights insist that the grain side next the pulley gives a better surface. The subject is a matter of opinion rather than a demonstrated fact. To run a belt successfully with flesh side to the pulley needs more careful and even skiving than is done on most cheap belts, whereas the grain is always smooth and even. Also, the thin grain surface is more pliable, and, for some uses, will "take hold" better.

(33) J. J. I. asks how large the anode must be in a silver electroplating bath to plate an article with 150 sq. in. of surface, and how much battery is required, and will old silver watch cases and spoons answer for the anode as well as new silver? A. The anode and cathode should be about equal in area. The amount of battery must be governed by the condition of the solution, quality of the work, etc. It should be as great as possible without making a hard or granular or brown deposit. Old silver will answer. Pure silver is better.

(34) M. J. B. asks: Is there any standard rule for measuring the candle power of a light? Can it be applied by a novice, or must it be done by an expert? A. Measurement of the candle power of a light is accomplished by comparing the shadow cast by a rod in the light of a standard candle with the shadow cast by the light to be tested. By moving the latter toward or away from the rod a point will be reached at which the shadow cast by both lights will be of the same intensity. The intensities of the two lights are directly proportional to the squares of their distances from the shadows, *i. e.*, suppose the light to be tested is three times the distance of the candle, its illuminating power is nine times as great.

(35) E. R., of Rochester, N. Y., asks how to make alum kid without using alum? A. We do not know of any such process. A soft white leather or dressed skin may be made in several ways without alum, but it does not take the place of alum kid. Nearly all our best qualities of kid are imported, the making thereof requiring more hand labor than our manufacturers can afford. The skin, after being relieved of the hair, by sweating in piles and liming in weak limes, is treated with a warm bran drench, and then, after thorough washing, with an alum bath and emulsion of egg yoke. These effectually taw, but do not tan the skin, and with repeated workings it comes out fine and soft.

(36) K. asks: How many cells of a "Grenet" battery would be necessary to run one incandescent electric lamp, either Edison's or Swan's? A. Six cells 4 x 5 inches will run one 8 candle power lamp.

(37) G. M. asks: 1. How is a good, clear, and transparent varnish for lithographer's use manufactured? I use a pure and fresh linseed oil for this purpose, but I cannot get a good, clear varnish. A. Canada balsam, 1 oz.; spirits of turpentine, 2 oz.; mix together. Before applying this varnish the picture should be placed in a stretcher and sized with a thin solution of isinglass in water and dried. Apply with a soft camel's hair brush. 2. Besides glue, what other kind of preparation can I use with success for sizing, writing, printing, and wrapping paper, and how is such preparation made? A. Glue and alum water is about as satisfactory a size as can be used. Besides isinglass mentioned above, a mixture of starch or dextrine and alum can be used. The cheaper sizes are made by heating clippings of hides, horns, bones, etc. The process is as follows: The articles, generally the first mentioned, are softened by soaking in cold water for a day or two; after that they are well cleaned by washing in running water. The next operation is to boil or rather heat them with water. The temperature should never be allowed to rise much above 85° C. (185° F.), as gelatine strongly heated for any length of time loses its power of gelatinizing. The operation should be conducted in an iron or copper vessel, provided with a false bottom or a casing outside, where steam may be introduced, and it should extend over about 15 hours. The solution should then be drawn off and filtered into some convenient receptacle. The residue can be again heated with water and a fresh quantity obtained, which may be added to the bulk. A quantity of alum (about 20 per cent of the clippings) dissolved in water is added. The size should be well filtered through woolen felt, after which it requires no further treatment.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

E. H. McI.—The black is hornblende, the white quartz, and shiny particles are mica. The mineral is of no value.—P. L. H.—The specimen is a variety of rock closely resembling gneiss. Its value as a building material depends upon its availability. It is frequently used for building purposes, but not, as far as we know of, for monumental purposes. It is not bluestone.—W. D. G.—The specimen is calcite (calcium carbonate), compact limestone.

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February 19, 1884,

AND EACH BEARING THAT DATE.

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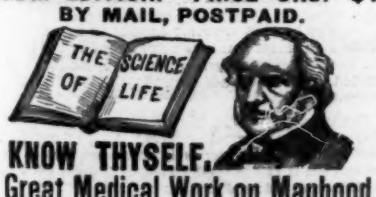

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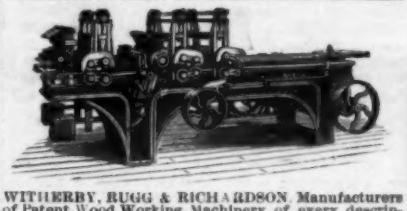

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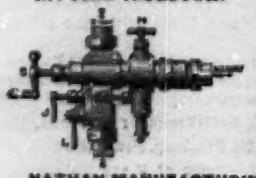

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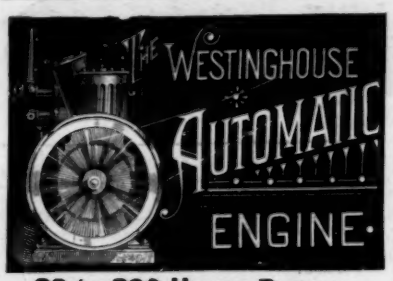

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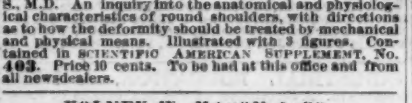

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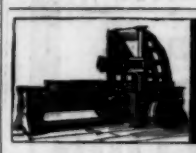

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